THE ENGINEERING MAGAZINE

THE WORLD IS ITS FIELD

VOL. XXIV. FEBRUARY, 1903. NO. 5.

THE OPENING OF THE ALASKAN TERRITORY.

By Harrington Emerson.

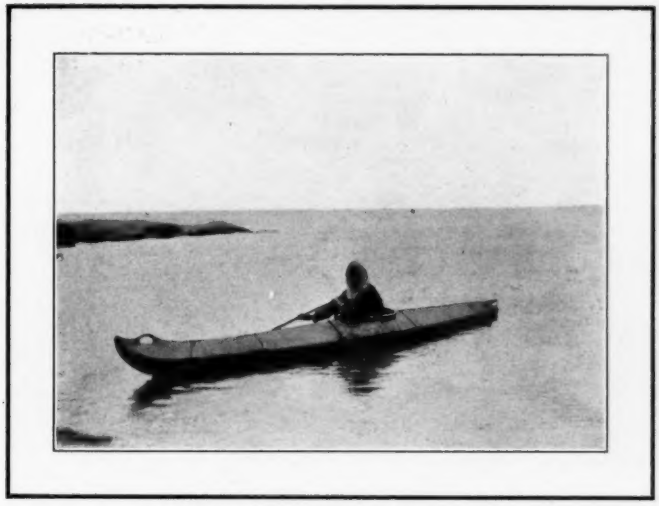
An acknowledged authority recently said: "Alaska will in the next thirty years produce more mineral wealth than the whole of the United States has produced in the thirty years just ended. No one has any conception of the possibilities of that country, to say nothing of its vast, almost incomprehensible extent." But Mr. Emerson is one of the few who have an adequate conception of the future of Alaska, and his estimate of it is based on extensive and intimate personal knowledge of the country under all sorts of conditions. The article following was written while returning from his most recent winter journey to the region. The illustrations are from photographs by E. A. Hegg and Kinne, and are copyrighted and may not be reproduced without permission.—THE EDITORS.

THE west, the old west of boundless natural resources and pathless solitude, to yield homes for millions yet unborn, is not exhausted. Governments and peoples do not realize it, but it lies there to reward the pioneer with greater and quicker returns than have been given by any part of western Europe or of temperate North America. The new and unsubdued west today is Alaska, almost to a mile one-half larger than the thirteen original American Colonies, very nearly twice the size of California, Oregon and Washington, as large as Great Britain, Denmark, Sweden, Norway, and the German Empire, and with a better climate and greater natural resources than an equal area of northern Europe supporting 10,000,000 inhabitants. This land, so rich, so fertile, has a seacoast of 23,000 miles everywhere accessible.

The Yukon, the fourth largest river in the world, navigable for more than 2,000 miles above its mouth and running in a great semi-circle from southeastern to northwestern Alaska, forms a natural highway. All this was known long ago; but it was not known that the interior contained 100,000 square miles of farming lands and almost limitless areas of the richest mineral lands in the world. It is in this unsubdued country that thousands of miles of railroad must be built, that great areas will open for settlement, absorbing and keeping busy two million workers as fast as they choose to go.

AN ESKIMO UMIAK LANDING AT NOME. THE DOG TEAM IS THE MODE OF SUMMER TRAVEL ON THE BEACH.

Alaska is a pathless country, and except as to its very accessible seacoast and the banks of the Yukon, it stands today where Europe was 2,000 years, and the United States 200 years, ago. The natives, gathered along the seashore and the river courses, always use water as their highway winter and summer. When not in boats they travel in dog sleds over the level ice of the frozen rivers or bays. In their boats there was traffic from Point Barrow in the Arctic for 3,000 miles down the coast to Puget Sound, and formerly a very considerable international trade was similarly carried on by way of Bering Strait, Chinese wares coming eastward and furs going westward. The kyak a small one-holed skin boat, the umiak, also a skin boat, will hold fifty people and all their belongings, and it is both a sea boat and a river boat. In summer away from the water the country is impassable, and the difficulties of transportation, as well as its importance for every enterprise, are inconceivable to those whose outfit, sole means of support, has not been landed on a bare beach, with a rising tide or storm threatening immediate destruction. There are a few extraordinary pioneers who without supplies, sometimes without firearms, will pass through 800 miles of trackless country, dressed and living like the natives. These men are comparable to the old *coureurs de bois* and the *voyageurs,* and their example is not to be followed. Had it not been for the natural summer highway of the Yukon, there could never have



A NATIVE EXPRESS IN SUMMER AT NOME.

been such a camp as Dawson. The head passes of the Yukon and the river itself were at that time the only possible direct road to the Klondike. Under such conditions the pack horse adds little to the solution of the problem. He cannot both work and forage. Men "packers" were at one time paid as high as 60 cents a pound for packing over the Chilcoot Pass, but the rate had been 10 cents. Over the White Pass, where horses could be used, the rates were never lower than 10 cents, and often 20 cents. Horse trains were maintained only by a constant fresh supply of horses from the south, few animals surviving more than two or three trips. Of 3,800 horses taken north in 1897, all but 30 died on the trail. To cheapen transportation a wagon road was hastily built in 1898 and a toll levied of 2 cents a pound. In 1899 this was succeeded by a railroad, and freight rates have fallen from the original maximum of 60 cents a pound for 40 miles, from water to water, to $3.75 to $5.50 per hundred pounds for the 2,500 miles from San Francisco or Puget Sound to Dawson. It is 112 miles by rail from tide water over the 2,800-foot pass to White Horse, below the dangerous rapids of the upper river, and to Dawson by the river it is 451 miles further. The fare from Skaguay is $70, and the fastest time made, 32 hours. In winter a sleigh road not following the Yukon, and therefore over 100 miles shorter, is opened north of White Horse to Dawson. The rates scheduled at the beginning of the winter were $165 per passenger, and for baggage in excess of 25 pounds, 40 cents to 50 cents a

HAULING THE UNITED STATES MAIL WITH REINDEER, NOME, ALASKA.

pound; but competition has cut the rate to $75, with extra charges of $5.50 a day for meals and bed. In the early part of the season the time was nine days, but it is hoped to cut this down to four when the snow road is hard and smooth. Scheduled freight rates are 30 cents to 50 cents a pound. In the year 1901 the White Pass Railroad carried 33,471 tons of freight and 16,472 passengers, receiving from passenger traffic $252,932.71 and from freight, express, mail, and telegrams $1,505,132.64, an average for freight of $43 a ton for 112 miles. Operating expenses, naturally heavy, were 42.42 per cent. of the receipts. The first cost of this road, including many expensive franchises and the buying up of possible rivals, was $4,250,000, and in the first season its gross receipts were officially reported to exceed $4,000,000, with operating expenses of about $1,000,000. The actual facts as to this highway into Alaska and the Yukon Valley are given to show the great difficulties and expense of transportation in opening up a new country, where in spite of a rapid fall in rates after the first season, a successful transportation enterprise will usually pay for itself with one year's earnings.

It causes regret to Americans that this brilliant undertaking, conceived and executed by American engineers, could find no American backers—that London, unhampered by the timidity which afflicts New York in presence of a new region, boldly and promptly investigated, financed, and carried it through. The headquarters of the road have

been moved from the United States to Vancouver, and the great bulk of the freight is no longer from the United States but almost wholly from Canada. As long as the British know how to grasp the new trade of the world, when and where it is most profitable, they have no immediate cause to worry about German and American competition.

Besides having enjoyed thus far the monopoly of the shortest entrance to the Yukon valley, the White Pass will remain the only approach to the rich Atlin country, a lake region just beyond the coast range, which is slowly but surely developing, producing this last season nearly $1,000,000 in gold. Atlin and the upper Yukon country will always be exclusively tributary to this road. As there is no other pass through which a road can be built, for an indefinite period the revenues of the White Pass route may be counted on to increase, but of the rich Klondike region with Dawson as its center it is likely very soon to be dispossessed. From the Stewart River 72 miles above Dawson to Nulato below the Koyukuk River, a distance of just a thousand miles, there are nearer and better seaports than Skaguay. The best of these is the bay of Valdez, 10 miles long and 3 wide, as protected and beautiful as a Swiss lake, and nearest of all salt-water harbors to Dawson. The first pioneers who were bound for this valley in 1898 attempted to reach it by passing over a glacier 4,000 feet high, and as they had to do their packing wholly by man force (twelve miles) the hardships endured were frightful. There is stirring reading in the United States Government reports made by Major Abercrombie, who

WINTER FREIGHTING OVERLAND, DAWSON, YUKON TERRITORY.

has traveled more extensively in this part of Alaska than any other white man. "Of the 4,000 who tried to go into the Copper River Valley in 1898 three fourths turned back the same season." Of the few who remained, "hundreds were dying of starvation beyond the Coast Range."

In 1900 and 1901 Major Abercrombie built a government trans-Alaskan military trail from Valdez into the Copper River valley. He paid no attention to the river route, nor to the twelve-mile short cut over the glacier, but surveyed and built a new road up the Lowe River and over a pass only 1,700 feet high, or 1,200 feet lower than the

WINTER FREIGHTING ON THE ICE, LAKE LINDERMAN.
(Copyright, 1898, E. A. Hegg.)

White Pass. Last winter over this road the freight rate to Copper Center, 103 miles, was 48 cents by dog team; during the summer by pack horse it rose to $1.50 per pound, as mud is much more difficult traveling than snow and ice. In October, 1900, the mail schedule from Valdez to the American Yukon was reduced to 20 days, and in April, 1901, the trip was made by the mail carriers in 13 days. Beginning the first of January, 1903, the mail contractors put on a weekly stage, four trips each way monthly between Valdez and Dawson. This winter, for the first time, it will be possible for American mails and American passengers to go to the American Yukon as quickly and as cheaply as over the Canadian route.

Five large ocean steamers, besides many sailing vessels, run each

DUTCH HARBOR, ALASKA. FLEET WAITING FOR THE ICE TO SOFTEN SO THEY CAN FORCE THEIR PASSAGE THROUGH IT TO NOME.

month between Puget Sound and Valdez, which is also connected by telegraph line with Eagle, Dawson, and the outside world. The increase of travel by this route is due to the discovery that the Copper River valley promises to be a great agricultural region, capable of affording homes to thousands of settlers, who will go there not because they can start bonanza wheat farms, but because the proximity of the great mining camps will give them a very high return for all

MINERS LANDING ON THE BEACH NEAR PORT CLARENCE, SEWARD PENINSULA.

SURF AT NOME, ALASKA.

they can raise. Fresh milk and butter, eggs and poultry, fresh beef and mutton, hay and oats for animals, fresh vegetables for men, command fancy prices. John F. Rice, Quartermaster's Clerk, in his official report to Major Abercrombie states that the city of Eagle is second only to Dawson in importance, that the route from Eagle to Valdez presents no such obstacles as routes through the Rocky Mountains or Cascades, that there is an abundance of grass from May until October, that the natural food resources of Central Alaska are caribou, moose, brown and black bear, mountain goat, geese, duck, grouse, salmon, pickerel, perch, bass, whitefish, trout, pike, and grayling.

It is, however, not the agricultural resources that will immediately attract the largest influx of population and capital. About 140 miles from Valdez in the Chittyna valley are very great copper deposits, which during the last season have been visited by many experts. Some of the ores run 85 per cent. copper, and there are many thousand tons in sight assaying 16 per cent. A great mountain slide has occurred in this region, revealing, it is claimed, as much as 40,000,000 tons of high-grade copper ores. Valdez Bay and the low pass north of it are the American gateways to the Yukon valley, and already a railroad has been surveyed and partially graded to the interior, for the copper, though it can be quarried like the iron ores of Lake Superior, without a railroad will remain worthless. The railroad itself is assured an unlimited tonnage. It is the shortest line to Dawson and the Yukon

valley, and which is of more importance, it can carry supplies delivered at Valdez from sailing vessels or deep-draft ocean steamers in all the months of the year, with only one break of bulk at Valdez, and also reach the deep navigable Yukon and the Koyukuk a month earlier than by the Yukon mouth, which is closed by Bering Sea ice until July 1. As shown in the history of the White Pass Railroad, the ingoing traffic would be in itself sufficient to warrant a railroad, but from Dawson the only export is gold, about 70 tons a year, while this road will not only carry all the United States Government troops and supplies, for which many hundred thousand dollars are spent, but it will have the unlimited outbound tonnage of high-grade copper ores, which, with a freight rate of $2 a ton from Valdez to the smelters of Puget Sound will scarcely be treated in the interior.

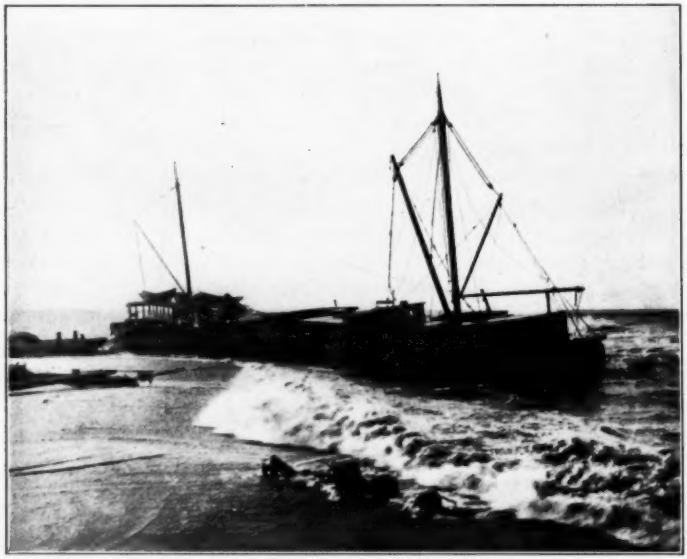
It is not too much to expect that improvement in transportation facilities alone will convert Central Alaska into as densely a populated and prosperous a region as Colorado, as the Black Hills of South Dakota, as the rich mining region of British Columbia.

There is another part of Alaska waiting for transportation facilities. It is not so dazzling as the Klondike nor as vast as Central Alaska, but it is perhaps richer than either of them.

Far to the northwest lies the Seward Peninsula, suggesting on the map an animal's head snarling across Bering Strait at the nearby Siberia. By rivers and sea it is almost wholly separated from the

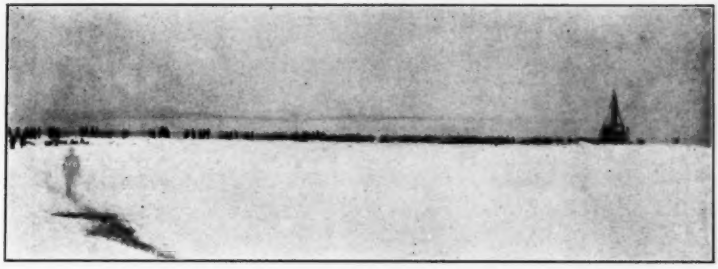
LANDING THROUGH THE SURF AT NOME.

mainland, and though comprising but 3 per cent. of the area of Alaska, or 20,000 square miles in 600,000, it has yielded for the last three years nearly 75 per cent. of the gold output, in spite of the increasing yield of the great quartz mines of the southeast, near Juneau. Although the most distant region of North America, 2,700 statute miles from Puget Sound, it owes the rapid exploration and development of its coast to the fact that an all-water route was open to its shores, and that freight still costing a minimum of $70 a ton into Dawson is being landed on the Nome beach for $10 a ton. Passenger rates, higher in the first rush, have fallen to $40 and $50 first-class and $20 or $25 steerage.



WRECKS ON THE NOME BEACH AFTER A STORM.

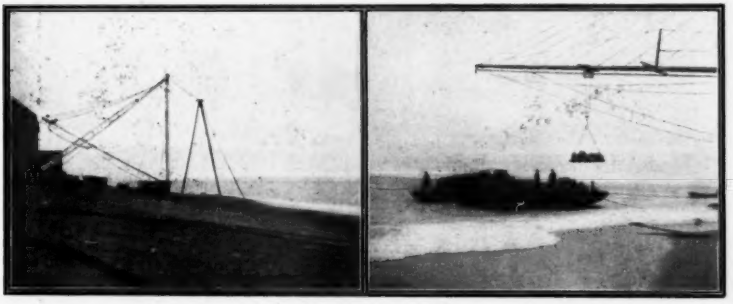
Owing to the freedom from hardships, as well as the low coast and shortness of time required, impelled by stories that were indeed true of rich golden beaches, about 25,000 people and their chattels landed on the low sandy spit at Nome and were left to the mercy of surf and storm. The Eskimo, very numerous along this coast, who have none of the aloofness of the Indian, came in their umiaks, big skin boats that can carry fifty people and all their belongings, and made camp with the whites; but the Eskimo, needing no barometer, intuitively flee several days before a storm. Not so the whites, who every year have been caught. In September, 1900, when there were more than 12,000 campers along the beach, the surf rolled in, wrecked much of the



LANDING PASSENGERS AND SUPPLIES OVER THE ICE AT NOME.

Cheaper than lightering through the surf. This explains the early rush every season.

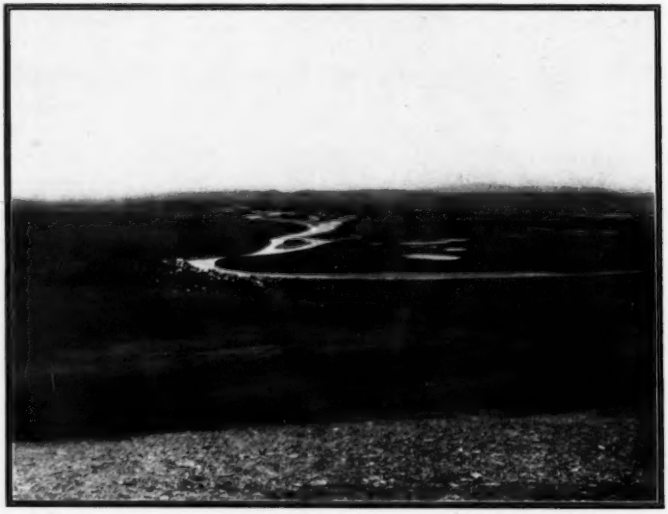
shipping in the offing, and destroyed about $1,500,000 of miscellaneous property on the beach, and every year since, similar if not so severe disasters have occurred. Driftwood, piled high landwards from Nome, shows that on occasion the sea sweeps the whole site of the present city. This is not the only danger. Another is fire. The streets are narrow, and the houses —flimsy wooden structures—stand in serried rows. Because of the cold there are hot fires everywhere. There are few brick chimneys, and in winter there is no water supply. If a serious fire should occur in midwinter, destroying shelter, food and fuel, no relief could reach the stricken people. The nearest open port on the Pacific is 500 miles to the southeast. It is 1,711 miles from Dawson, with no roads to either place. Bering Sea is in the same latitude as the Baltic, and like the Baltic is shallow and brackish owing to the many rivers which empty fresh water and silt into it. In winter surface ice readily forms, extending 300 to 400 miles south of Nome, effectually isolating the city from November 1 until June 1. This is unendurable, and three projects are under consideration to effect communication throughout the



DERRICK FOR UNLOADING SCOWS AND BARGES, NOME BEACH.

FREIGHT BOAT OF THE NIUKLUK RIVER. CARRIES 7 TONS.
The horse tows it up-stream, riding down in the boat.

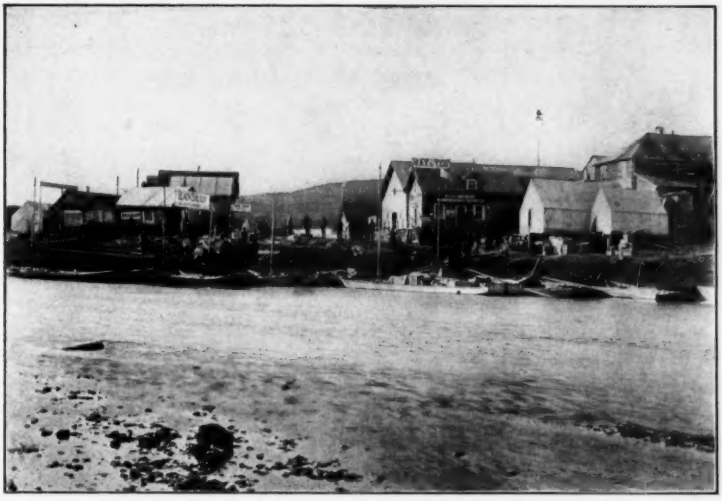
whole year. The simplest is to maintain in Bering Sea an ice breaker of the Admiral Ermak type—an easy task, as the ice is not as thick and solid in Bering Sea as in the northern Russian ports. The second project is to build a railroad from Cook Inlet or Prince William Sound



COUNCIL CITY AND THE FLAT NIUKLUK VALLEY, LOOKING TOWARD THE SEA.

on open Pacific waters to Nome by way of St. Michaels. The third plan is to connect Nome by railroad with the lower Yukon River, and ultimately effect a junction with the railroad from Valdez to Eagle. To complete this project would require about 900 miles of track.

The gold yield of the Nome region has hitherto come from the sea beaches and from gulches and beaches at most 10 miles from water transportation. Even 10 miles has proved almost prohibitive. In winter the placers are not worked and the camps are closed. No advantage can therefore be taken of the smooth snow and ice roads. In summer the tundra is two or three feet of mud, with a bottom of frozen



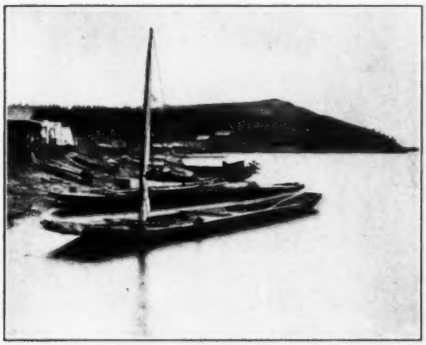
THE COUNCIL CITY WATER FRONT, LINED WITH FREIGHT BOATS.

ground. The services of teams are worth from $20 to $40 a day, and it takes a whole day to haul 1,500 pounds 10 miles. The lowest rate is three times as much as the minimum from Puget Sound to Nome, 2,700 miles, and twice as much as the rate from San Francisco or Puget Sound to Dawson. So prohibitive were the natural conditions that Mr. Chas. D. Lane, of the Wild Goose Company, considered it wise economy to devote 90 per cent. of the output of certain placer claims to a transportation system, thus reducing cost of exploitation for all future output to 10 per cent., rather than indefinitely to spend 90 per cent. of the yield for transportation alone. The Wild Goose Railroad, 7 miles long from Nome to Anvil Creek, earned its total first cost within 30 days of its opening and shows increasing earnings each year. From Council City, on the Niukluk River about 90 miles from Nome,

Mr. Lane has built a second road, also 7 miles long, connecting Council with Ophir Creek, and this road has also paid for itself in one season. Council is 55 miles from the nearest seaport, up a shallow winding river. That part of the Seward Peninsula on which Nome is located, a part about 5,000 miles in area, was geologically speaking, very recently an island. A deep indentation of the ocean runs 50 miles inland from Port Clarence, northwest of Nome, and Golofnin Bay, about 70 miles east of Nome, also extends many miles inland. These two bays are joined by a deep valley, so that 60 miles north and inland from Nome it is possible with one short portage to go from sea to sea.

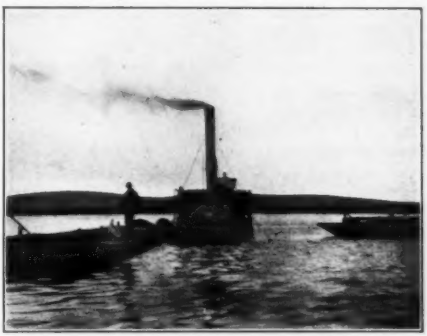
TOW BOAT, GOLOFNIN BAY. IT GOES OUT TO OCEAN STEAMERS AND TOWS LOADED BARGES UP THE FISH RIVER.

Council City lies in this depression, Ophir Creek and innumerable other rich creeks emptying into it from both sides. Gold has been found in paying quantities on nearly all of them, but it is impossible yet to develop them, owing solely to the cost of transportation. To develop one placer claim on Ophir Creek Mr. Lane not only built the seven-mile railroad, surveying it after it was finished, but he also put on from San Francisco to Golofnin Bay two schooners, one with auxiliary power; to connect with the schooners he built a shallow-draft stern wheeler and a number of steel barges, carrying 20 tons, which carry his supplies to White Mountain at the upper end of the delta of the Fish River. Here everything is for the second time unloaded, warehoused, and when water permits, transferred to very light wooden boats drawn



FLEET OF RIVER FREIGHT BOATS, ON THE FISH RIVER AT WHITE MOUNTAIN.

by horses, and carrying about 5 tons each. These boats are often dragged by main force over the gravel and sand bars between White Mountain and Council, 35 miles up the river. At Council everything is again transferred to a warehouse, reloaded onto the railroad, and carried to the end of the line, there again to be warehoused and ultimately carried by wagons over to the mining camp. To Council from Golofnin (55 miles) the freight rate by water is $40 a ton, and from Council to Ophir by the railroad (7 miles) also $40 a ton. The yield of one claim on Ophir Creek in one year has paid for the whole transportation, equipment, and operating cost from San Francisco to Ophir. Owing to the absence of transportation facilities nothing is being done further inland, but a railroad from the nearest port to the interior, a narrow-gauge railroad, should pay for its cost each season for many years to come. There are no heavy grades, no mountain work, and for many miles it runs through a heavily timbered country, but west of Council there is no timber and both lumber and fuel are exceedingly high in price. There is not only gold here, but also what gives promise of being one of the richest lead and silver districts in the world. Seventy miles inland from the ocean, up the Fish River and its tributary Omilak Creek, less than 50 miles by railroad survey, silver and lead ore has for 18 years past been quarried out, the ore running from 70 per cent. to 80 per cent. lead and about 120 ounces of silver to the ton. Much ore lies sacked on the dump, but in small quantities of several hundred tons it costs more to



AGROUND ON A SANDBAR.

FIRST PASSENGER TRAIN, WILD GOOSE RAILROAD.

move it than it is worth, although its smelting value exceeds $100 a ton. From Golofnin Bay there is a freight rate of $3 a ton to the Tacoma smelter, but the wagon haul to the river and the transportation down the river is as yet prohibitive. This one quarry, if properly equipped and opened, should yield a minimum of 10,000 tons a year, and it might grow to 100,000 tons.

For Pacific Coast maritime evolution Alaska has been of inestimable advantage. The Dawson rush of 1897 and 1898 impressed every available boat, and when it was over left well established lines with almost daily service. The Nome rush of 1900 again caused a demand for all available craft, and in summer the regular service keeps a fleet of more than a dozen ocean steamers busy. The Valdez developments even now justify weekly sailings. All the worn-out dilapidated craft of American register drift into these runs, and as the Alaskan coast is for the most part unchartered, unbuoyed, and unlighted, many of them find their graves in northern waters.

The export trade from Alaska for four months ending October 31. 1902, exceeded $20,000,000, and was equal to that from Hawaii (for ten months ending the same date), was three times that of the Philippines, and more than double that of Porto Rico. The island dependencies of the United States are densely populated, small in area, and fairly well developed. They are in the tropics and unfit for white men and their families. Alaska needs 10,000 miles of railroad, 20,000 miles of wagon roads and telephone lines, and can, as fast as transportation is available, give homes and employment to a population of 10,000,000.

THE UTILISATION OF MOUNTAIN WATER POWERS.

By Paul Letheule.

The development of the high mountain water powers of France and Switzerland affords most interesting and useful examples of pioneer work in a field which is rapidly growing in importance with the advance of practice in long-distance electrical transmission. The precedents—both mechanical and economic—to be found in the undertakings described in the following article are valuable in connection with current or prospective work in the Highlands of Scotland and the Pacific Coast of North America.—THE EDITORS.

THE first *Congrès de la Houille Blanche* marked a new epoch in the electrical development of mountainous districts, its primary object being to facilitate the utilisation of the water power so plentiful in the Alpine districts of France. The accomplishment of this was naturally beset with obstacles, and the work of the Congress was, to a considerable extent, of legal character, as no step could be taken towards the realisation of the possibilities foreshadowed without first removing, by liberal legislation, the many difficulties presented by reason of the vested interests involved.

A TYPICAL ALPINE WATER POWER.

The legal considerations affecting the question, however important from a local standpoint, do not present a general interest, and are secondary in importance to the economic problems. The technical solution is not the least of the important factors which go to make a practical success of the possibilities. The mechanical and electrical features of an installation must naturally be taken into account when endeavoring to realise the best means of obtaining good economical results. This is especially true in that which concerns the harnessing of such variable sources of power as torrential rivers and mountain streams, like those found in such abundance in the Alpine districts of Europe. The mechanical installations by which they are successfully utilised, the effective solutions worked out for the problems of power generation and transmission, the costs of maintenance and operation, and the industrial development resulting, are of the widest possible interest and value in helping to determine the methods of obtaining the best results from enterprises of this nature elsewhere.

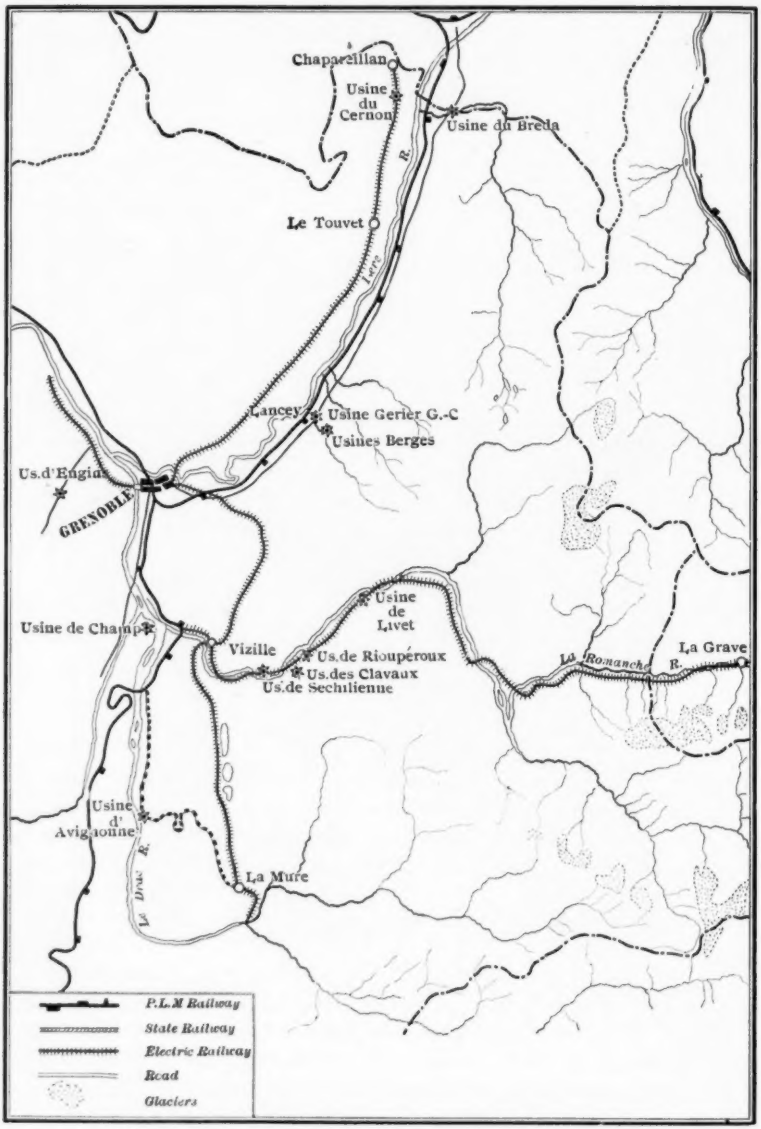
The best illustration of the economical, industrial, and technical aspects of the question can be given by briefly reviewing the characteristics of a few typical works of the kind.

A great variety of methods might be expected if we remember that the main installations utilise very widely varying heads and volumes of water-falls—volumes varying from 40,000 litres to 50 litres per second, and heads in some cases as low as 25 metres and in some as high as 620 metres. The common difficulty of all these installations is that due to the great quantity of débris carried by the stream; the greatest care has to be given to the intake, settling chamber, and conduits. Another characteristic of all but a few of these streams is the absence of any natural or artificial reservoirs for storing the water

SUBTERRANEAN SOURCE OF A FRENCH ALPINE STREAM.

and modifying the irregularities of the flow, which are, for all these rivers, very large. None the less interesting, though exceptional, are the artificial reservoirs in existence or of which the construction is planned.

Most variable conditions are thus met with in the harnessing of the water powers of this region, and naturally modes of utilisation are



MAP OF THE DISTRICT ABOUT GRENOBLE, WITH ITS WATER POWERS.
The small towns and villages are omitted.

sought permitting similar variation in respect to the amount of energy which can be profitably consumed. Among the most promising applications in this particular is to be cited the electro-chemical, which is excellently suited to the irregular character of the water power available; but this has been seriously handicapped by the keen competition in calcium carbide production and other industries from more recent installations in foreign countries, so that the market value of those products has become insufficient for a remunerative business.

Light and power are delivered in great profusion to districts which unfortunately do not present a large centralisation of population and industries. Workshop and home industries may offer interesting developments in connection with the distribution of cheap energy, and as an interesting instance might be cited the use of hundreds of sewing machines, run electrically at the cost per day of 10 centimes per machine.

Larger customers for power are usually paper makers, wood sawers, oil makers, tile makers, printers, etc. In the field of traction belong a few original mountain railroads or tramways, which deserve a more than passing notice. Much progress however remains to be achieved in the way of utilisation of energy, but in this as in many other cases, the first step made in the aid of development of local industries was to equip the available power, and then to discover outlets for the energy.

The rendezvous of the Congress was in Grenoble, a city of about 70,000 inhabitants, near the junction of the river Isère and its tributary the Drac, two copious streams, capricious at all times, the latter of which has on several occasions threatened destruction* and partial devastation to the now flourishing and industrial city which obtains a new source of life from these unruly torrential streams. The industries which are part and parcel of the life and success of this city are more or less tributary to the constant output of energy now derived from the waterfalls. These are the cement industry, the glove factory and dependencies, with a yearly production of 40,000,000 pairs; leather dressing and tanning, skin and fur dying, the furriers' trade, the manufacture of buttons and clasps, distilling, hat making, and wood working. Great supply of power is available within easy reach of the city, so well situated at the junction of two rivers which offer, or whose tributaries offer, a number of well equipped waterfalls. South of Grenoble is the Drac valley; southeast, the Romanche valley; north, the valley of the Isère.

* A complete devastation took place in the Middle Ages.

The valley of the Drac river and its tributary the Romanche affords typical power-producing centres, the most interesting of which it is proposed to review below. It is to be remarked that the two main waterfalls on the Drac river are of quite different character and have nothing in common. Both are so interesting that it is necessary to devote a description to each. Of the water powers on the Romanche

A CHARACTERISTIC VALLEY STREAM AND VILLAGE IN THE FRENCH ALPS.

river, which have all been devoted to the electro-chemical industry, some have failed to prove remunerative, and special attention will be given to the critical condition which they are in and the features appertaining thereto, especially in the case of the most powerful and best equipped. The Livet station, which is in every sense a typical Alpine hydraulic plant, and which lately abandoned the electro-chemical industries to devote itself only to power and lighting distribution, has achieved by this means an apparent success.

The Isère valley is characterised by power installations with a high head of water, which seem to be most typical of the idea attached to the designation "*Houille Blanche.*" Small streams falling down in precipitous and picturesque cascades, rocky mountains cov-

THE "WHITE COAL" OF FRANCE AND SWITZERLAND.

ered with vegetation and large forest domains, lofty steel conduits climbing the hills in a nearly vertical ascent, as seen in background on page 681—such are the conditions prevailing in the watershed of the Isère, where the falls are often 500 to 600 metres high, and where as much as 1,700 metres head will ultimately be used by means of three power stations at Lancey.

From this renowned spot, which was the very cradle of the art of water-power installation in France, and which is situated about 15 kilometres northeast of Grenoble, on the river Isère, were started the excursions of the different parties attending the *Congrès de la Houille Blanche.* We will not concern ourselves with following the very leisurely programme which was pleasantly accomplished in the time at their disposal, but confine ourselves to the above outlined programme of inspection and examine successively the main characteristics pertaining to the power installations of the three definite valleys already described in the following order: Isère, Drac, and Romanche.

The first of the high falls of the Isère valley, both in order of in-

stallation and in interest, are those of Lancey, the first and until very recently the highest* of their class ever equipped. The mention of these falls would be incomplete without the name of Aristide Berges, who identified himself with these works from the very start, and who with the help of his sons is pushing them to their full development.† The natural conditions prevailing in this privileged locality were all particularly favourable to the realisation of M. Berges' schemes. Lancey is a low valley encircled by the very steep slopes of the Belledone mountains, of the average height of 2,500 to 3,000 metres, covered with high forests which prevent the range being denuded by torrential streams.

First among the latter the Combe torrent was used for operating the Berges paper factory, which is run entirely by mechanical power from the waterfalls. Its power plant includes 12 turbines of an aggregate of 4,000 to 5,000 horse power. Its annual production of paper exceeds 10,000 tons; of pulp, 3,500 tons, and of cellulose, 4,000 tons. To this first installation using the power at Lancey were added a lighting and traction plant which will be dealt with later.

As early as 1868 the first conduit for bringing water to the paper factory was installed at Lancey with water from the Combe stream under a head of 200 metres. The volume of water amounted to 500 litres. To this first fall were added a few years later the waters available from two small streams derived from the same Belledone mountains, with the resultant volume of 500 litres per second under a head of 500 metres. All has been working without a hitch, and the promoter, M. Berges, states that no difficulty of any sort has been experienced from the high head of water. The conduits have proved resistant to oxidation, and their performance has led to the hope that they will last a whole century, whether placed in the open air or underground. Coal-tar paint mixed with carbon sulphide offers a sufficient protection. Joints and corner pieces have shown good resistance to the pressure due to 500-metres fall. Outlet pieces of hard bronze or aluminium last a sufficient time, and the same remark applies to the various valves or gates. The turbines themselves are easy to build and to operate and show as good an efficiency as with average heads. The greatest difficulty experienced is in respect to the volume, which shows a relative variation of range from one to ten at Lancey.

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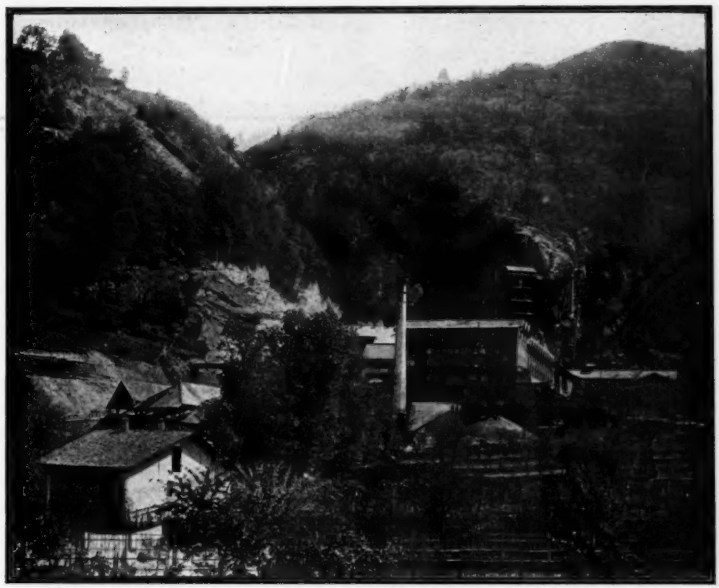
* The fall of 620 metres, above mentioned, up to recently held the distinction of being the highest fall ever equipped, a record which has lately been eclipsed by a Swiss waterfall, which unfortunately cannot be described here.

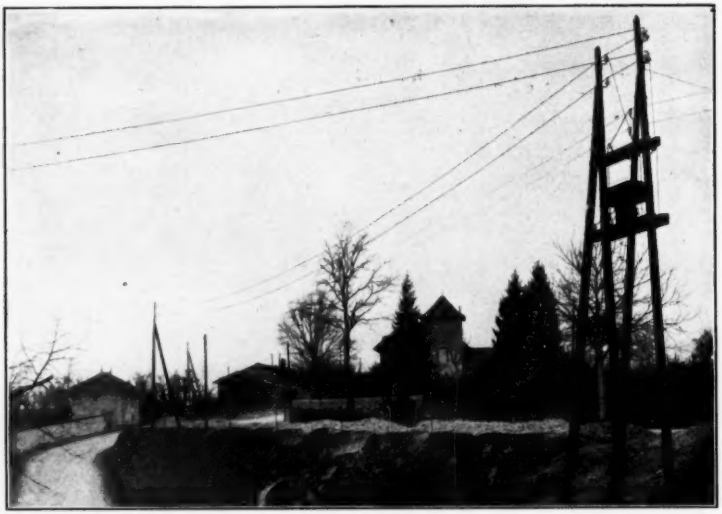
† He is the originator of the picturesque and expressive term "Houille Blanche."

M. Berges has proceeded with very far-reaching views and with very scientific methods to the regulation of the flow—a regulation which is already secured in part by the construction of a retaining dam at the outlet of a lake situated on the Belledone mountain, and which will be completed by the interconnections of similar lakes and the installations of new power stations fed from these lakes. The average amount of power thus assured for the whole year round, on that small basin of 44 kilometres area, is estimated to be 10,000 horse power regularly, from three power stations, the first one now in existence and using the first waters mentioned. The first station utilises two falls of a total 500-metres head and 500-litres volume; the second station, a fall of 527-metres head and 500-litres volume; the third station, a fall of 514-metres with a volume of 800 litres. The first station is now sufficient for the paper factory, as well as the lighting and tramway service in their present states.



LANCEY POWER PLANT, VALLEY OF THE ISERE; BELLEDONE MOUNTAIN IN THE BACKGROUND.

The paper factory uses mostly mechanical energy, from 12 turbines aggregating 4,000 to 5,000 horse power, applied to driving saws, wood grinders, elevators, etc., which are operated by mechanical transmission from the shaft of the turbines. These latter are moved by



10,000 VOLT TRANSMISSION LINE AND 3-KILOWATT TRANSFORMER ON THE POLES, VALLEY OF GRÉSIVAUDAN.

the action of water jets, 20 millimetres in diameter, at the periphery of the wheel. Four of these small jets are sufficient for a 600-horse-power turbine.

By reason of the high speed of the water, reaching to about 60 metres per second,* the peripheral speed of these turbines is very high. Thus they affect the form of a narrow wheel of large diameter, the 600-horse-power type measuring 4 metres in diameter, and 5 centimetres only in thickness. To the paper factory is added a continuous-current generating set for production of hypochlorite, used for bleaching the pulp.

The lighting station is intended to generate electric current for a lighting distribution extending a radius of 15 kilometres in length in the Grésivaudan valley. The building and the mechanical installation are similar to those of the plant just described. The following are the characteristic features of the whole of the installation:

Four single-phase alternators feed the high-tension line by means of oil-insulated step-up transformers. The line voltage is 10,000, the frequency 50 cycles. Great economy has been combined with sufficient safety in the construction of the cross-country high-tension lines,

* The theoretical speed $\sqrt{2gh} = \sqrt{2 \times 9.81 \times 500}$ = about 100 metres. The turbine peripheral speed amounts to 65 per cent. of this figure.

which have a total length of about 50 kilometres. The engraving opposite shows the wooden pole construction used throughout, as well as the special arrangement supporting the line transformers stepping down the voltage for 120-volt distribution circuits. These line transformers are paraffine insulated, like the station transformers, and fitted with a protecting cap, as shown in the picture.

The lighting charges are so low that the incandescent electric lamp is in general use even at the remotest farms. One of them, for instance, visited at random, uses one 10-candle-power lamp at a charge of 25 francs per year, a second lamp at an additional charge of 15 francs, and three 5-candle-power lamps at a charge of 15 francs total —altogether 55 francs for 35 candle power, or 1.6 francs (32 cents, or 16d.) per candle power per year.

The tramway generating station installed at Lancey is owned by the *Compagnie du Tramway de Grenoble à Chapareillan,* and is operated on the three-wire system. The company do not own the falls, but buy the water power from M. Berges for their machines situated near the paper factory, paying 100 francs per horse power year, with a minimum guaranteed consumption of 25,000 francs a year, which corresponds to an average continuous load of 250 horse power. The average load is lower, but the maximum sometimes reaches 1,000 to 1,500 horse power. The only line operated connects Grenoble (70,000 inhabitants) with Chapareillan (2,200) a distance of 43 kilometres, thirty-ton trains with a half-hour schedule being run in the suburbs of Grenoble and one-hour schedule on the country line.

The voltage drop and distribution losses due to the great length of the line are still more greatly emphasised by the nature of the profile and the distance from the generating station, which is three kilometres distant from the nearest point of the line. These losses would have been prohibitive with an ordinary 600-volt distribution, or would then have necessitated the use of several generating stations. Preference has been given to the three-wire system which was adopted for the first time at this locality and which has had very few imitators since. The current is carried to the cars by a three-wire system with two overhead conductors used as outside wires with 1,200 volts difference of potential, and the track rails as a neutral with 600 volts difference of potential to each of the overhead wires. The current is received by two series-wound motors connected in series, their common point being used as a neutral and their outside terminals being connected with the two overhead trolleys of the car. Yet in spite of this arrangement the voltage drop is relatively large in the feeder

circuit of the tramway. This is composed of three feeders with areas of 64, 125, and 90 square millimetres, and voltage drop of 250, 150, and 400 volts respectively, boosted up at the generating station, electric booster sets, each composed of one motor and two generators, boosting symmetrically the two wires of the feeder. The motor is run from 1,200-volt bus bars. The track is crown bonded and connected to the neutral bus bar of the switchboard by a conductor of 125-square-millimetres section.

Drac Valley.—Of a very different character is the Drac river, which is estimated as capable of rendering 100,000 horse power in the Department of the Isère alone.

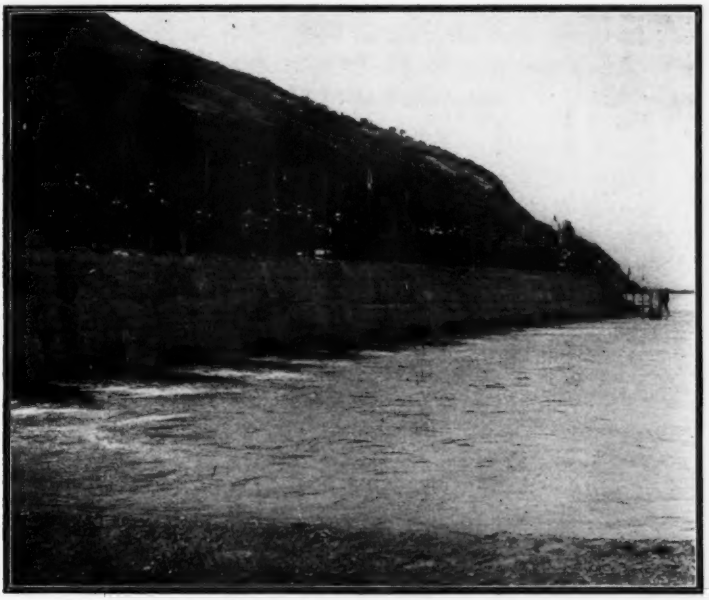
The first installation to be mentioned is the Fure & Morge plant at Champ, near the junction of the Drac and Romanche rivers, 15 kilometres distant from Grenoble. This plant is exclusively for the distribution of power. The second installation is up stream from Champ, on the Drac river, near Avignonet, but the local conditions are so different at these two stations that very different arrangements have been adopted.

The flow of this capricious river may vary from 20 to 1,200 cubic metres with a violence which is not tempered by any obstacle whatever to its mad rush, as there are no forests along its valley. The Drac at Champ presents the aspect of a shallow river, the width of which, in high water, may exceed 1 kilometre, and would expand still further if it were attempted to confine it by a large dam. The same river is cramped up at Avignonet into a very narrow neck, eminently disposed for the construction of a solid retaining dam.

The water has been taken from the Drac at Champ by means of a low dam in the bed of the river, a dam which is constantly under the river level, but yet is sufficient to create a current of water from a side outlet of a width of 16 metres, bordering a long intake provided with gratings, in the form of light shutters, preventing the ingress of stone and rubbish, of which the river carries a great deal. The river current passing alongside of the intake shutters favours the discharge of gravel and stones through the outlet. What passes the shutters enters the settling basin, which has a surface of 3,000 square metres, and in which the water settles before entering the flume.

This flume, built in the gravel and earth and lined with hydraulic cement, varies in width from 60 metres to 22 metres and in depth from 1.50 to 4 metres, and runs a length of 600 metres with a maximum slope of 4 millimetres per metre. It ends in a second settling basin provided with sufficient discharge drains. This basin is built with two

parts separated by a dividing wall, the first part for sedimentation, the second for supplying the conduit. This opens about 2.70 metres under the level of water in the charging chamber, and the admission of water to the conduit is controlled by gates arranged, not directly on the conduit, but at the entrance of the second chamber, so that a sudden emptying of the conduit will not result in vacuum effect, but in admission of air to the conduit pipe.



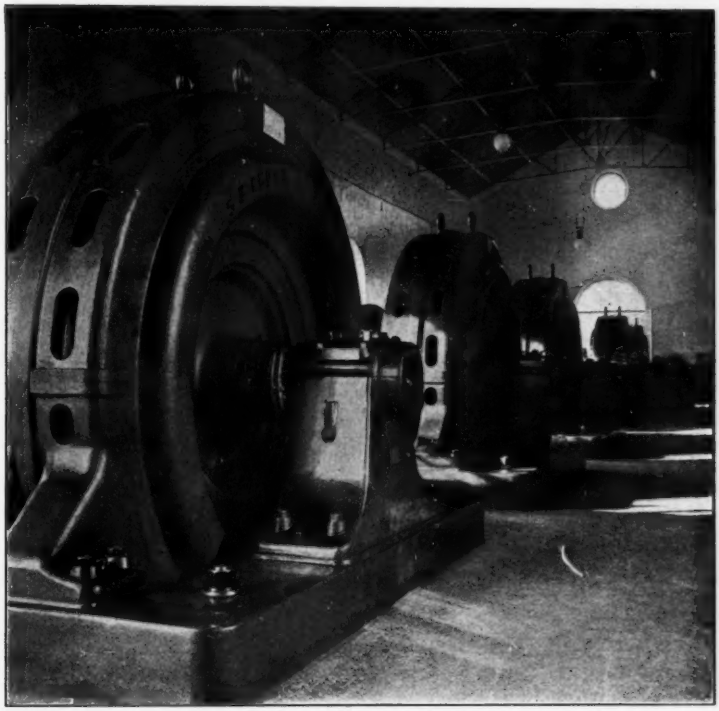
HEADWORKS ON THE DRAC RIVER.

Of the 4,600 metres of conduit, 3.3 metres diameter, 2,100 metres are reinforced concrete, and 2,500 metres steel. The concrete part of the conduit is used for supporting pressure up to 20 metres depth of water, its total thickness being 0.020 to 0.025 metres. A network of circumferential and longitudinal rods is embedded in the cement, the circumferential rods having a thickness of section varying from 11 to 22.5 millimetres and the longitudinal rods sections varying from 6 to 12 millimetres. The reinforced concrete conduit rests on a bed of concrete with a thickness of 0.3 metres and is buried in the earth to a depth of 2 metres. The steel conduit, 2,500 metres long, is similarly embedded and also placed on concrete supports, a practice which is quite uncommon, but presents many advantages in connection with large

sectional conduits. The conduit is made of sheet steel from 7 to 15 millimetres thick. In this mode of construction and arrangement no expansion or deformation need be feared, nor any injury from impact or water hammer, although this conduit contains the immense mass of 40,000 cubic metres of water running at a speed of 2 metres per second. As a precaution against impact, three air chimneys or shafts have been specially disposed on the length of the conduit, a precaution which is often used here for impact protection. An unusual precaution, additional in this case, is the use of compensation gates, which will be again referred to in the description of the generating station. Below is an outside view of the station showing the vertical shaft tube.

The Champ generating station is a well lighted two-story building set on substantial concrete foundations. The connecting cables and transformers are placed in an underground chamber, well ventilated and provided with a 10-ton crane and track connecting with a repair

DOWNSTREAM SIDE OF THE CHAMP STATION, SHOWING TAIL RACE AND OPEN AIR SHAFT.



DYNAMO ROOM, CHAMP GENERATING STATION.

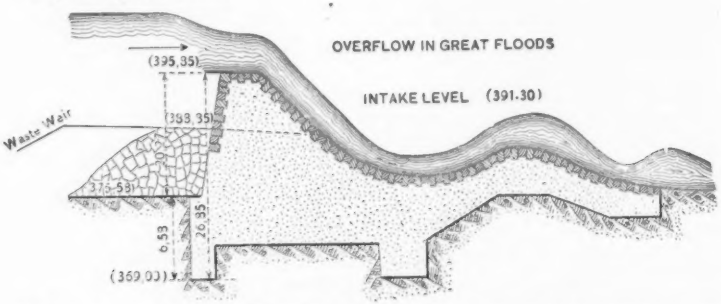
shop forming part of the station. Oil-bath type of transformers are used, cooled by water under pressure.

The ground floor contains the dynamo room, 44 metres long and 12 metres wide, provided with a 15-ton crane. The first floor contains the switchboard and arresters and also the engineer's apartments. The main generating groups are composed of 1,350-horse-power Brenier turbines coupled with three-phase alternators, running at 300 revolutions per minute. The couplings are the elastic rubber type, as generally used in hydraulic plants on the continent, but the rubber, in variance from common practice, does not work with expansion but by compression. Besides the main machines, the station includes two 150-horse-power exciting sets and a 5-horse-power turbine for feeding the water accumulator used for regulation.

Regulation of the main group is made by means of hydraulic servo-motors operating the admission distributor of each turbine and the

compensating valve shunting the turbine. This couple of gates is designed for a constant admission of 4 cubic metres of water, which flows entirely through the turbine at full load, and in part through the compensating arm at fractional loads. The flow of water is therefore regular and free from any inertia effects likely to result from the quick action of the turbine regulators.

The 1,350-horse-power alternators are rated for this output with 80 per cent. power factor. They are of the Brown-Boveri revolving-field type, wound for 3,000 volts. Step-up transformers are of the Brown-Boveri three-phase type, each rated for 1,150 kilowatts; their principal features consist in the oil bath and the water circulation, and double secondary voltage. This latter possibility has been arranged for as a preliminary precaution against eventual difficulties liable to be met with in operation at 26,000 volts. The contemplated voltage of 26,000 volts is obtained from these transformers with the windings star connected, and the delta connections derived at the switchboard will give 15,000 volts.



DAM ON THE DRAC NEAR AVIGNONET. FIGURES ARE ELEVATION IN METRES ABOVE SEA LEVEL.

No difficulty whatever has been experienced in the station and line operation, which have been in regular service since March 15, 1902, under 26,000 volts. Regular distribution of power has since that date been made to fifty-seven works, exclusively for motive-power purposes.

The main high-tension line is supported by poles common to this and another company, operating at 26,000 volts, a condition seldom met with. The common line has a length of 36 kilometres. Secondary derivations of the line made by this company are made of 6, 5, and 4 millimetre wires supported by wooden poles by means of blue-glass insulators of American manufacture, tested at 80,000 volts. Horn arresters with liquid resistances are used throughout. Sectional

switches are similarly provided with horn projections. The 26,000 volt current is received in eleven transformer stations feeding the distributing network at 1,000 and 2,000 volts.

The following data of conditions of station and line operation and costs, as well as of the actual status of affairs, have been obtained through the kindness of the director, M. Lépine:

The minimum available flow of water measures 17 cubic metres per second, the total head 37.40 metres, reduced to an effective head of 32 metres by losses in the gratings, canals, and conduits. Thus the minimum hydraulic power in kilogrammetres per second is 17,000 × 32 = 544,000.

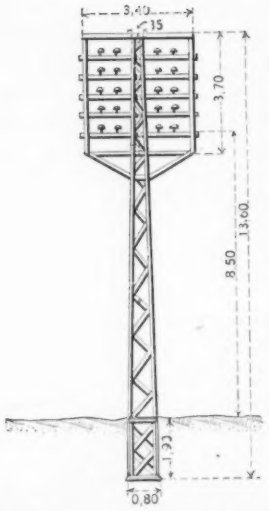
Actual efficiency of		turbines	=0.76
"	"	" alternators	0.94
"	"	" transformers	0.975
"	"	" main line	0.94
"	"	" secondary line and transformers	0.90
Total efficiency			0.58

Actual effective power available on the secondary network, 3,160 kilogrammetres per second, or 4,176 horse power. Each horse power year is actually sold at 125 francs for a 12-hour-day load and 150 francs for a 24-hour-day load.

3,300 horse power are now contracted for, for a period of thirty years, at the expiration of which the contracting parties will own the installation. This arrangement is a very original one, and it has since found some imitators, at least in one French installation of the same sort, dealing mostly with municipal lighting or municipal contracts for private or public lighting and power.

Avignonet Station.—The Avignonet station is exposed to the same variations of flow and to the same difficulties in respect to the suspended matter and gravel carried downstream by the force of the flow; but here the small width of the Drac has permitted the construction of a high retaining dam, which is one of the most distinguishing features of the hydraulic plant (page 688). This dam is 20 metres high, with a thickness of 24 metres at the base, and 4.75 metres at the top, and concrete foundations 7 metres in depth. The parts of the dam exposed to erosion are rock-faced.

The dam is so high that it is overtopped only in time of great floods. Most of the water flowing in the stream above in ordinary stages is carried by the flume, which is 840 metres long and has a capacity of 39 cubic metres per second. It is built underground as a



HIGH TENSION LINE AND POLE, CHAMP AND AVIGNONET PLANTS.

protection against injury by landslides or falls of rock. A spillway with movable weirs is provided at one side.

At the end of this short canal and before the water enters the penstock, there is a settling basin. The penstock leading to the generating station is 2.2 metres in diameter, and the same general features characterise its construction as in preceding installations.

The generating station contains seven generating units, three-phase Creusot alternators direct coupled to turbines of 1,750 horse power. The frequency and terminal voltage of the machines is the same as in the preceding installations, and part of the high-tension line is common to the Fure & Morge Company, as before stated.

The main characteristic of the alternators installed here is the direct winding for 26,000 volts, which is a very exceptional voltage for a generator without step-up transformers.

High-Tension Line.—A preceding paragraph referred to the line of this plant. The accompanying figure illustrates its construction. One side of the pole shown is reserved to the Avignonet installation and the other to the Champ plant. Inter-connection and sectional switches are disposed at various places, together with lightning arresters for protection against atmospheric discharges. The arrangement of the lines promotes the facility of repairs, as one side may be grounded for a time, when needing repairs, while the other side is utilised temporarily. Incidentally it may be mentioned that these metallic poles are more expensive than the ordinary wooden erections. The pole above described costs, completely installed, 500 francs.

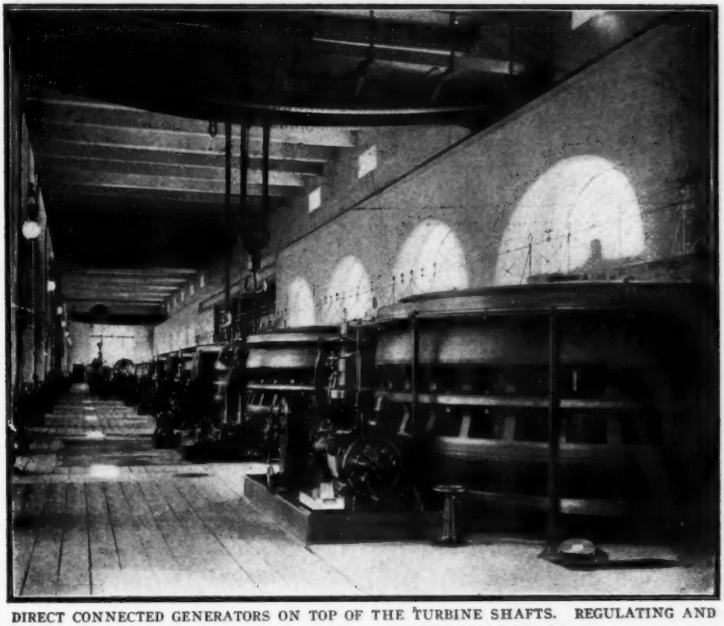
This plant is unlike that at Champ, which generates current only for lighting and power. The principal customers are *La Compagnie des Mines de la Mure*, the *Cie des Tramways de Grenoble, au Villard*, and several manufacturers of Bourgoin which is situated at a distance of about 100 kilometres from the generating station. The prices are about the same as those before quoted, and the operation has been very successful, in spite of the high voltage directly generated.

Romanche Valley.—Further up-stream on the Romanche river from its junction with the Drac, which point of junction is occupied by the Champ installation above described, are a number of interesting works which have made a rich and prosperous district out of this once poor and desolate valley, or at least were doing so until the carbide crisis put a limit on this increasing prosperity. In a length of 20 kilometres along this valley are to be found no less than six plants, aggregating from 30,000 to 40,000 horse power, destined for the utilisation of power for mechanical, electrical, or electrochemical purposes. The following are among the most notable:

Sechilienne plant, generating energy for the calcium carbide industry.

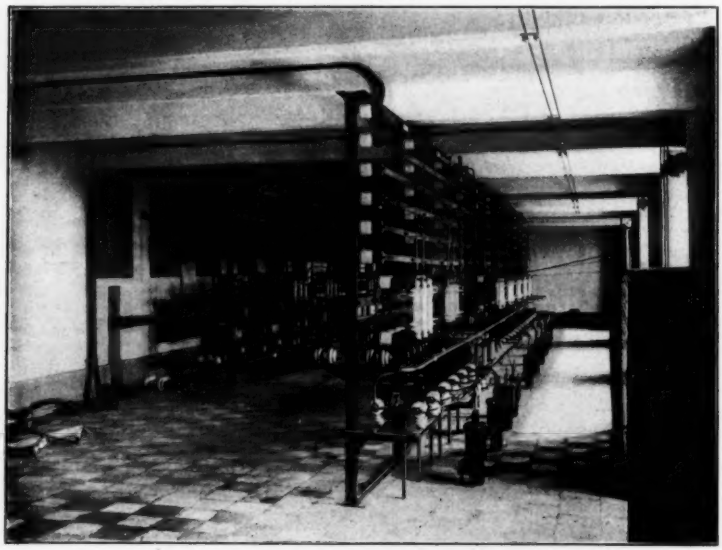
Chavaux, which supplies power for the same purposes and also for electrolytic processes in the manufacture of sodium and sodium chlorates.

Vizille and Riouperoux, for mechanical drive of paper factories, these latter using two falls, 35 and 40 metres in height, through eight turbines with an aggregate power of 7,000 to 8,000 horse power.



DIRECT CONNECTED GENERATORS ON TOP OF THE TURBINE SHAFTS. REGULATING AND CONTROLLING MECHANISM IN THE FOREGROUND.

Livet Station.—A short distance up-stream is the Livet station which is very interesting in its hydraulic features. The station was built for the calcium-carbide industry, and is now undergoing changes to enable the supply of energy for light and power to the town of Grenoble, 35 kilometres distant. In addition to points common to other stations already mentioned, this displays certain features due to its



HIGH-TENSION SWITCHBOARD AND LIGHTNING ARRESTERS.

well-known designer, M. Drouhin. He sums up thus the difficulties to be met and the precautions he would recommend:

1. The avoidance of an embarrassing deposit and accumulation of gravel, silt, etc., in the stream.

2. The reduction of the speed of flow of the water entering the settling basin so that it may deposit there, rather than in the flume beyond, its suspended matter.

3. The removal of the floating débris in the flume and the admitted surface waters.

4. The construction of the dam to resist the sudden and violent floods to which the rivers are subject.

5. The protection of the toe of the dam against wash and undercutting.

6. The protection of the canal and flume against damage by fall-

ing rocks, landslides, or similar accidents and the arrangement of the canal with such a slope as to allow the deposit of suspended matter.

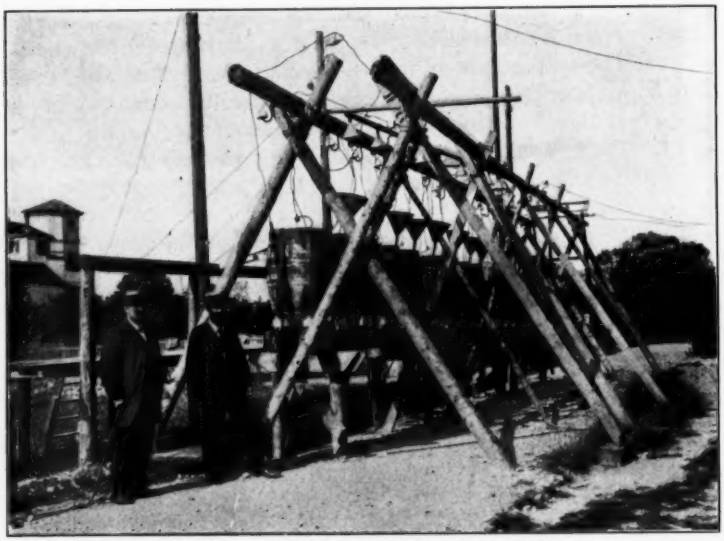
7. The arrangement of matters so that in case of accident at the generating station the turbines could be shut off without injury to the penstock and without emptying the flume.

8. The protection of the flume and penstock against the effects of sudden overflow and against the danger of being pierced by falling rocks.

Piling in the bed of the river below the dam may be used to prevent cutting by the falling water and the gravel and stone it carries. The intake is best placed at least two metres above the bottom, to escape the suspended matter carried along the bottom; floating débris

INDICATING AND REGULATING MECHANISM FOR HYDRO-ELECTRIC GENERATING STATION.

may be removed by suitably disposed gratings. The first settling chamber should have a capacity equal to at least fifteen times the volume of flow per minute at the intake gate. It should be convenient of access and provided with drains for emptying and flushing it. There should be several settling chambers along the hydraulic canal to permit the subsidence of as much as possible of the silt. In no case



TEMPORARY RIGGING FOR HIGH-TENSION WORK.

should the speed of flow through the canal exceed 2 metres per second. Underground construction is advisable in many Alpine districts as a protection against destruction by landslides or avalanches.

The station equipment at Livet includes five generating sets of 1,250 horse power at 350 revolutions per minute, carbide type of alternators, 70 volts, 46.6 cycles, Thury system. New sets will be installed for the supply of current to Grenoble, with the understanding that the owners of the plant put up the transmission line, transformer stations, and secondary network at their own expense and risk, the city agreeing to pay them a yearly subsidy of about 100,000 francs for 45 years. They have further the exclusive right of power distribution in the city with a guarantee of the consumption of a minimum of 1,400,000 kilowatts yearly at the following prices:—for lighting, 0.12 franc per kilowatt for the first 1,000,000 kilowatts, and 0.06 franc per kilowatt for all above the first 1,000,000; for power, 0.03 franc per kilowatt. On yearly contract, the price per horse power per year is to be not more than 120 francs nor less than 70 francs.

The minimum power consumption guaranteed by the city is based upon the expected abandonment of municipal gas lighting and water distribution, and will in all probability be largely exceeded and additional demand be made upon the capacity of the small Engins station.

FOUNDRY MANAGEMENT IN THE NEW CENTURY.

By Robert Buchanan.

III.—MOULDING BY HAND AND BY MACHINE.

Mr. Buchanan's first article appeared in our issue for December and dealt with the general arrangement of the foundry, heating and ventilation, and the supply of tools and minor plant. His second paper discussed crane service for the foundry floor. The next will take up the purchase of supplies.—THE EDITORS.

OF the total castings made in foundries at least three-fourths are made in moulding boxes, or, to use the American term, flasks. The number and fitness of the available moulding boxes is thus a matter of the greatest importance,

Foundries in many cases have their stock of moulding boxes neither large nor fit, and it is the one with good boxes sufficient in number which survives when the stress comes of dull trade and low prices. In some foundries a box part is considered past use only when it has become dangerous to use, or has dropped out about three times in one day. If it drops out only ocasionally it is not considered as being anything worse than not just so good as it ought to be. It would be well if moulding boxes of doubtful character were made to be a credit and profit to their owners by being re-melted and cast into ones which will not drop out.

Seeing that moulding boxes are a necessity, it is the foundryman's duty to provide these in such numbers and with some such system as will obviate any waiting by his men or delay in the execution of orders. How to do that without tying up too much capital in the plant is what I shall now consider.

Where the greater number of patterns are bedded in the floor, there the moulding boxes may be least in number. To make moulds well by the system of "bedding in" of patterns requires, on the whole, a higher measure of skill on the part of the moulder than does the "turning over" or "rolling over" of complete moulding boxes. Such higher skill has to be paid for in most cases, and in addition, bedding in a pattern will, with only a few exceptions, take longer to do than turning or rolling over. We thus get back to the old question of time to be paid for or tools to be provided.

In planning the moulding boxes to do jobbing castings, or work

A PART OF THE LOAM DEPARTMENT, FOUNDRY OF THE GENERAL ELECTRIC CO., SCHENECTADY, N. Y.

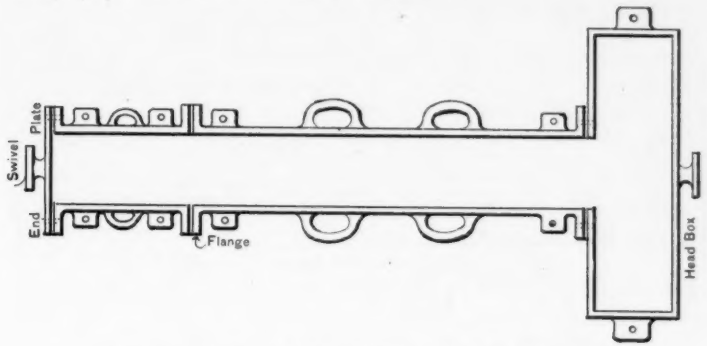
which is not of a repeat character, a system of interchange of parts is valuable, giving as it does a full service with a minimum of outlay. This interchange of parts may be made available for box parts made in sections, or for box parts cast all in one. To obtain the full advantage of interchange of parts the holes in the snugs, whether for fixing the guide pins or for the pin passing through, ought to be bored to templates. It is as easy to bore the holes in the correct position as otherwise; it only requires a little more care and precision. The exceptions in which cast holes may be used will be exemplified later on.

To shew the system of interchange let us take a set of moulding boxes suited to make pipes or columns in 9-feet lengths or odd lengths longer or shorter than that. Make the pattern of the moulding box so that it will cast to 10 feet long. Cast two tops and two drags or bottom boxes, each having suitable bars as shown on the opposite page.

In addition to the two 10-feet lengths, pipes or columns over 20 feet long or down to 2 feet 3 inches inside the flanges, may be readily cast by casting from the same wood pattern one pair of boxes to each of the following sizes:

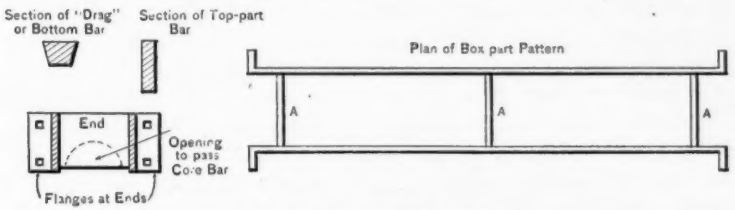
One pair moulding boxes 8 feet long, one pair 6 feet long, one pair 4 feet long, one pair 3 feet long, and one pair 2 feet long.

One flat top part and a few end plates and head boxes complete the outfit. It is well not to have the head boxes too narrow. Narrow head boxes save ramming, but are not suitable if brackets are wanted cast onto flanges. An easy fit in head boxes also allows the casting to contract freely without risk of pulling the flanges off. Another way in which sections may be made to do double duty is by making midparts in sections, the sides of the midpart being made to serve tops and drags of different breadths but the same length.



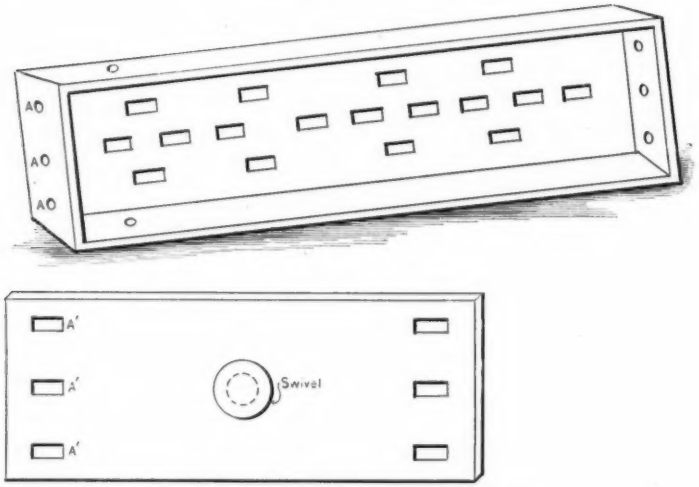
ADJUSTABLE FLASK FOR MOULDING PIPES OR COLUMNS.

If two sides, upper figure, page 698, be say 6 feet long, these will form sides for any size moulding box of which the length is 6 feet. Ends, separate, give the breadths required, the bolt holes being cast elongated as shewn to allow for adjustment in suiting the pins and pin holes of the top and drag if so required. If one has a range of moulding boxes consisting of tops and drags from 6 feet by 4 feet, every 6 inches up to 6 feet by 6 feet, by having ends of the different breadths one pair of sides is made to do for five sizes of midparts. There is the time spent in changing the ends to be considered, but this can be done



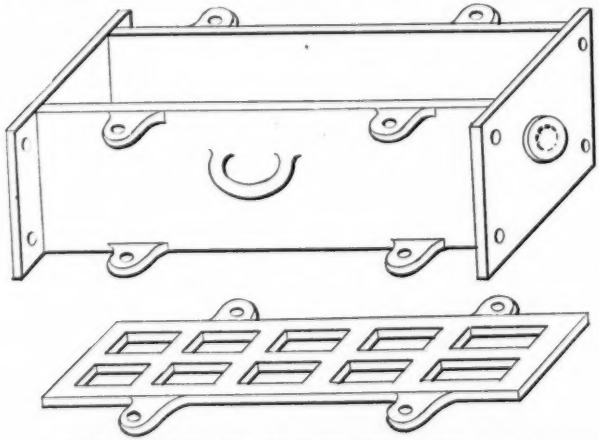
PLAN OF BOX-PART PATTERN.

A, A, are bars in wood pattern to hold it together. These are filled up when moulding the top or bottom bars.



SIDE AND END OF MIDPART MADE IN SECTIONS.

by an unskilled worker in a short time. The advantages are, less money in the plant and less yard room occupied by the boxes. The slots along the middle of the side help to lighten it and provide easy means of venting the mould itself or any cores in the vicinity of the slots. Vents of cores should not be on the joint of a mould if they can be got through the side. If bow handles are put on they ought to project



MIDPART AND GRATING FOR CONVERTING IT INTO A DRAG.

enough to clear the flanges, so that the chain hooks may readily be attached. In the lower figure opposite is shewn a midpart turned into a drag or bottom box by the simple expedient of casting a stiff grating in open sand and bolting it on to the four snugs of the midpart.

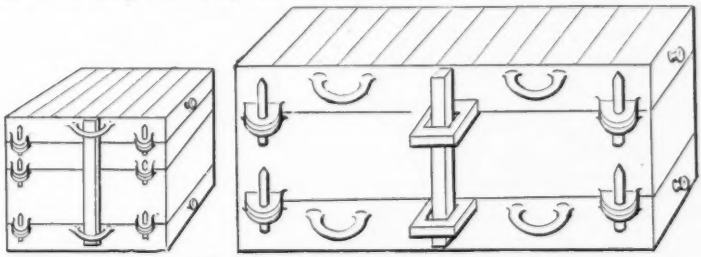
In making midparts which are cast all in one it is best to have these of a depth to make various combinations with top and bottom moulds, and thereby be able to suit exactly any pattern which will go into the length and breadth of the moulding box. Suppose we set about to make a box part 48 inches by 48 inches and wish to provide for the future. The pattern is made 8 inches deep and from it we cast a top and bottom part, then we cast

Two midparts 8 inches deep.

One midpart 6 inches deep.

One midpart 4 inches deep.

With these, leaving the drag or bottom box out of consideration, there may be exactly fitted in height patterns of ten different heights from 4 inches to 26 inches. Care must be taken that these midparts have the snugs correctly bored and fitted.



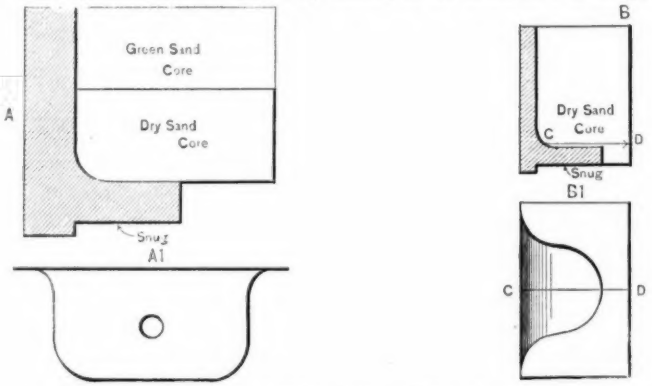
STAYING THE MIDPARTS OF LARGE FLASKS.

When midparts are long or are built high, and the pressure of the fluid iron in casting is likely to bulge the box parts where they are unsupported, this may be provided for by casting a large snug on each side of the top and bottom parts. In each snug is a 3-inch-square hole through which a bar, square in section, is passed from one snug to the other. The midparts are stayed by wood or iron wedges inserted between the bar and the midparts. In others the bow handles may be so used. See the illustration above.

In making moulding boxes it is important that the snugs be exactly at right angles to the side and at least ⅛-inch up from the face. Many a moulding box has been spoiled by the carelessness of the moulder in placing the snugs too low. The fitter has to chip and file the snug thin before he can get the box part to bear on the corners of

the frame. This snug may give way at a critical moment and so cause the loss of an important casting. Snugs should be amply heavy and have a good angling where they join the frame. Many foundries use a loose wood-pattern snug, and when the snug is drawn from the green-sand, cover over the top by means of a slate or iron plate with a covering of oil and parting sand next the metal. With such means it is impossible to have a good angling and a strong snug. A better plan is to form the top of the snug in a core box, if for large moulding boxes. For small moulding boxes form all but the bottom of the snug in a core box. See A and B, in the figure below.

Snugs of large box parts which are subject to great strains, but not great enough to require holding down by means of binders, ought to have snugs as A1, below. This shape gives space for the "cramps" or "clamps," as they are variously called, to be fixed to the snugs, a

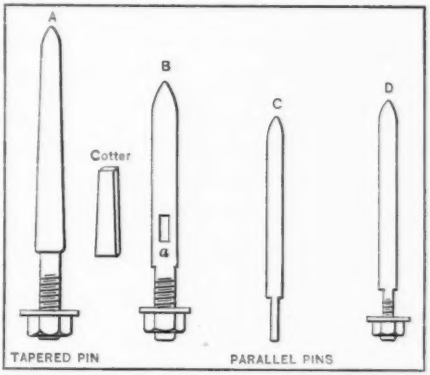


SECTIONS SHOWING HOW TO FORM MOULDING BOX SNUGS PROPERLY.

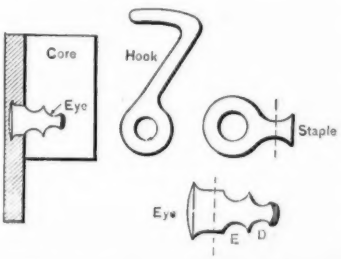
space not so available on rounded snugs. The cramps hold the various parts of the moulding box together when turning or rolling over the mould, and also when casting.

Pins for Moulding Boxes.—On page 701 are illustrated a few pins which are much used. A is a tapered pin with the shank and body joined by a gradual increase in diameter instead of having a sharp shoulder. The taper of the pin allows the mould to go from the vertical when being parted. The taper pin is allowable only for short lifts and must be square at the shoulder. B is a parallel pin with a cotter hole through it. The under part of the cotter hole at A must be a little under the line of the snug of the top part, so that the cotter will tighten itself between the snug and the upper part of the cotter

hole. This pin is excellent for fast working. Where casting strains are not great the cotter-pin allows of the moulding box being fixed ready for casting within a few seconds of closing the mould. The pin is made of a heavier section than the others to make up for the weakening effect of the cotter hole. C is a pin which is used to best purpose only on small box parts, and is then rivetted in. It is often used on large moulding boxes and is fixed in the pin hole by means of three moulder's sprigs, or in some other unsatisfactory way. It is thus the cause of endless waste of time and misjointed castings. This pin ought to be left to its proper place as of use on small box parts only. D is a useful pin for lifts from 4 to 24 inches, or longer if required. It may be transferred from one box to another at very short notice, and when screwed into position by means of the nut, causes no bother by coming loose. It is used on boxes up to the largest sizes. Unless in fairly constant use, box parts having screwed pins with nuts should have the pins taken out when the boxes are sent to the yard. When box parts are sent to the yard with the pins in, they should be placed so that the pins hang downwards. This keeps them from wasting at the neck so readily as they would otherwise do, and so prevents them working loose. Pins in crane box parts should never be rivetted in. If they work loose they cannot be tightened again unless with a great deal of trouble.



PINS FOR FLASKS.

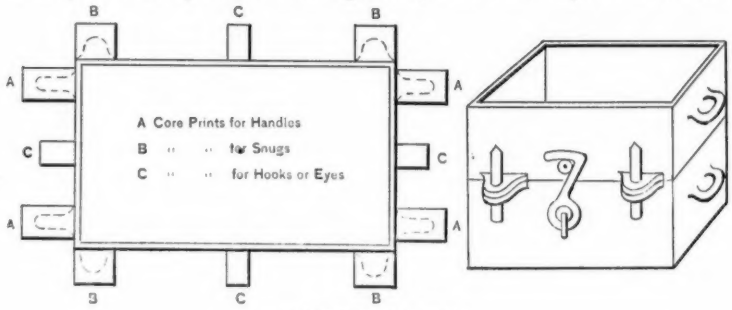


FITTINGS FOR REPEAT-WORK FLASKS.

Moulding Boxes for Repeat Work.—In making moulding boxes for castings in constant demand, it is hardly necessary to say that in suitability for the patterns to be moulded and in the fit and equipment of the box itself the very best obtainable is none too good. I shall consider these box

parts as being designed to be lifted by hand and this may be done with boxes up to 4 feet by 4 feet. For the larger sizes of hand boxes the thickness of metal tapers from ⅝-inch to ½-inch, and in the smaller from ½-inch to ⅜-inch, the lesser thickness being at the joint.

Box-part patterns when cast ought to be machined true on the face. On these are screwed prints for the snugs, handles, and hooks and eyes. These pattern moulding boxes, when the complement of box



FLASK FOR REPEAT WORK.

parts is cast, are kept carefully for future use, either for replacing breakages or for extending the outfit of boxes. There are similar patterns for each running size. The patterns having snug and handle prints in position require no verification as to correct position when next they go into the foundry to be worked from.

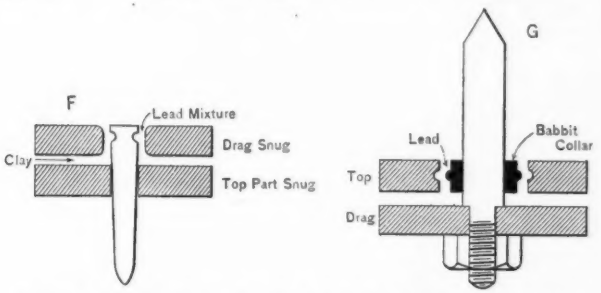
It may sometimes be possible to use, with the same drag, top parts differing as regards depth or width of bar, so that jobs may be changed by changing the top parts only. In making midparts, when these are required, the pattern of the drag may be used, the bars stopped off in the sand, and the cores carrying double snugs, double hooks, etc., may be used.

The casting into the sides of the drag of the staple carrying the hook, and casting the eye into the sides of the top, completely obviates the need of any fitting as regards these useful adjuncts. This is done by printing the iron pattern of top and drag as mentioned, ramming the connected hook and staple into one core and the eye into another core, allowing the end of the staple or eye, as the case may be, to project and be held by the metal.

The steps or different diameters on the eye allow for working the box parts with or without plate patterns. For turning or rolling over a plate pattern the hook would engage at D, in the figure foot of page 701; when closed ready for casting the hook would engage at E.

A method of fitting small moulding boxes for use with plate patterns, or ordinary patterns, for that matter, is by fixing in the pins by means of a mixture of lead and zinc poured round the pin. This is largely used in some parts of Great Britain and makes a very good fit. The snugs of the top parts are bored to a template. The snugs of the drags have cored holes, the holes having a countersink both ways, and are half an inch or so larger than the pins. The parallel pins as F, below, are made to stand vertically in the top-part holes. A thin piece of stiff clay is then made to surround the pins, over which is placed the drag, the large holes in the snugs of which allow the indented ends of the pins to come up through. The lead and zinc mixture is then poured round the pin. This plan makes a good fit even if the top-part holes are not bored exactly to the template. The pins will stand a surprising lot of work without coming loose. If they do come loose, the lead mixture is melted out and the pin re-fixed by pouring as before.

Another method somewhat similar to the above is shewn in G, below. In this the large hole is in the top-part snug, and is cast with a small recess to hold the lead in position. The holes in the drag snugs are bored to template and the pins are held by a nut on the under side. A babbit-metal collar, smooth inside, but roughed outside, is dropped over the pin, making an accurate but movable fit. The



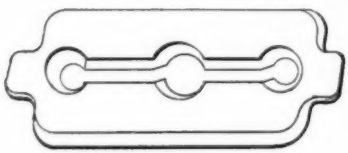
PINS FOR FITTING SMALL FLASKS FOR USE WITH PLATE PATTERNS.

drag is placed upon the top part, each collar coming up into the large holes in the drag snugs. Lead or a lead and zinc mixture is now poured round each collar and so fixes it. With turned pins this makes the best fit of all I have mentioned. For sustained accuracy it is unequalled, and may be arranged to suit parallel or taper pins.

In designing box parts see that bars, sides, and snugs are well proportioned, as much repairing will thereby be avoided. For the

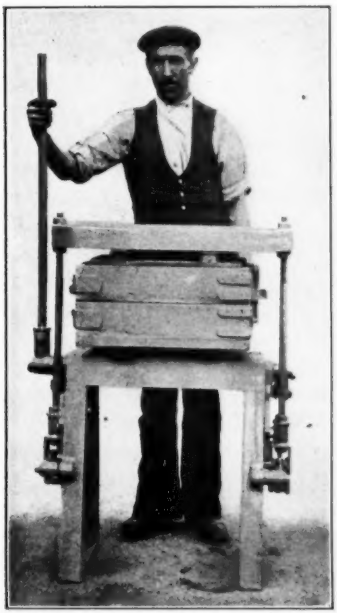
same reason, and also the added one of safety for life and limb, put the best iron into the moulding boxes. It is neither wise nor economical to use rubbishy iron for this purpose.

Use of Snap Flasks.—Snap flasks are used in Great Britain to a very limited extent, but are largely used in the United States. In Great Britain it is probable that their use will become more extended as time goes on and foundrymen become acquainted with their uses and capabilities, and also with their limitations. Knowledge of the latter is not unimportant. The snap flask, I may explain for the benefit of the uninitiated, is usually made of wood, is hinged at one corner, and has a catch at the other. When the sand is rammed and the mould made and closed, the snap flask is released by lifting the catch and so allows the flask to open. The mould is then transferred to the floor by means of a bottom board, of which there is one for each mould. The snap flask is now ready for making the next mould. These moulds, having no box part to hold them, have weights of the same area as the moulds placed upon them for the purpose of holding them down and so preventing straining or lifting. Suitable openings are made in the weights through which the metal is poured into the runner or "git." The number of weights required by each worker of a snap flask is what will cover the number of moulds which he can cast with one hand ladle of metal. After pouring into the moulds the contents of each hand ladle, he transfers the weight from those he has just cast to those about to be cast. About six or eight weights will thus be found sufficient for each worker.



WEIGHT FOR SNAP FLASK.

When the moulds are put on the floor they are placed firmly one against the other so that each mould is supported on two sides, with the exception of the moulds first and last in each row. Beginners have considerable difficulty in pouring them, so that they shall not run out, but that is overcome as experience is gained. Snap-flask moulding is largely confined to castings of a light character which are shallow in depth and not extensive in superficial area. When castings are deep the sides of the mould are readily burst out, and the same thing may hapen if the superficial area demands fast pouring so that the surface of the casting may be without flaw. There is a large field, however, for snap-flask moulding where the risks mentioned are quite avoidable. The use of this mode of moulding is certain to increase, considering what a small outlay for plant it requires.



HAND-PRESS MOULDING MACHINE. For light work in flasks up to 18 by 15 inches. Samuelson & Co., Ltd., Banbury.

An almost indisputable adjunct to the snap flask is the sand press. The various methods of working patterns, whether loose patterns, using odd-sides, or with plates, or any modifications of these, may be applied on the sand press. With plate patterns the top and drag are pressed or rammed at the same time and with the same movement of the lever. The sand press is not adapted to make three-part moulds unless with very special arrangements which need not be detailed here.

Beating the Moulding Machine.—A moulding machine is one in which the sand is rammed or pressed by compressed air, steam, or hydraulic power, and in which the pattern is made to leave the mould or the mould to leave the pattern, by mechanical means. This leaves out of consideration the numerous machines which are rammed by hand, whose sole function, and that a useful one, is accurate drawing of the pattern from the mould.

We hear of the great number of moulds which may be made in a day using these machines, and comparison is made with the number made by hand in a similar time, to the disadvantage of hand moulding. A moulding machine was set to work on a new plate pattern and by the time the day's cast was over 1,250 castings, each about 2 pounds weight, had been made; and yet, taken week by week, that machine was a failure as regards cost, when compared with the cost of similar castings made by hand. More castings per plate pattern may be made per day by the machine, but the labour attending the machine, the upkeep of the machine itself, and the supply and conveyance of power to work the machine, may counterbalance much of the advantage of increased output obtained from one pattern.

It is misleading to compare an outfit of ancient box-parts made of cold-blast iron (as the hot blast had not then been invented), in which

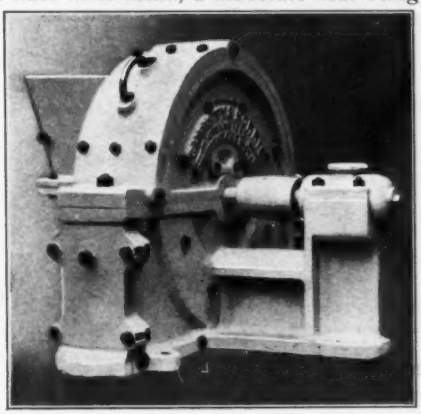
SPECIAL PLATE-MOULDING MACHINE FOR REPETITIVE WORK.

Samuelson & Co., Ltd., Banbury.

is worked an iron pattern which has been filed for half-an-hour by one who knows nothing of moulding or a moulder's requirements, with the use on a moulding machine of a pattern and plant which are the product of the best skill of the expert. If the same qualities of precision and exactness in fit and finish of patterns and general plant, and the same supervision, attention, and energy, be devoted to the working of patterns by the best hand methods as are usually given where machine moulding is practiced, then hand moulding, except in specialised cases, is in small danger of being ousted, at least in the near future. What the future contains no man knows, but the day of the moulding machine for general work is not yet.

Coal Dust.—In making coal dust for moulding purposes one would expect that coal containing the greatest percentage of carbon would be the most suitable, and yet it is not so. Anthracite with fixed carbon 93 per cent, and ash 7 per cent, made into coal dust, gave the casting a spotted appearance, each spot indicating where a particle of the coal had been. The remainder of the casting was dark and dull. Using an ordinary coal containing hydrocarbons, that is, a bituminous, long-flaming coal having 14 per cent. ash—the spotted appearance was absent and instead there was a very much lighter, brighter skin on the casting, uniform in appearance all over. Everyone knows the appearance indicated, and it is due to the absorption by the red-hot casting of the hydrocarbons liberated from each particle of coal by the heat of the newly poured metal. Carbonic oxide gas also probably assists in forming the skin on the casting. A mixture of equal quantities of anthracite and bituminous coal in the facing sand gave an appearance in the casting midway between the pure anthracite and the pure bituminous coal. The spotted apearance of the anthracite was there, but the body of the casting was lighter than when using anthracite alone, and this lighter appearance was undoubtedly due to the bituminous coal present. The total weight of coal dust used in each test was the same.

It is well for foundrymen who have not reliable sources of supply to make their own coal dust. How to test the materials offered in the market will be shewn later on. To make coal dust, the fine coal is dried on a plated floor, with flues underneath, a moderate heat being used so as not to fire the coal, or volatilise in any appreciable degree the hydrocarbons contained in the coal. When the fine coal has cooled it is ground in a mill having two French burr stones, the under one being fixed and the top one running. The stones are horizontal, and the fine coal fed into a hole in the middle of the top stone is ground as it passes towards the circumference of the stones.

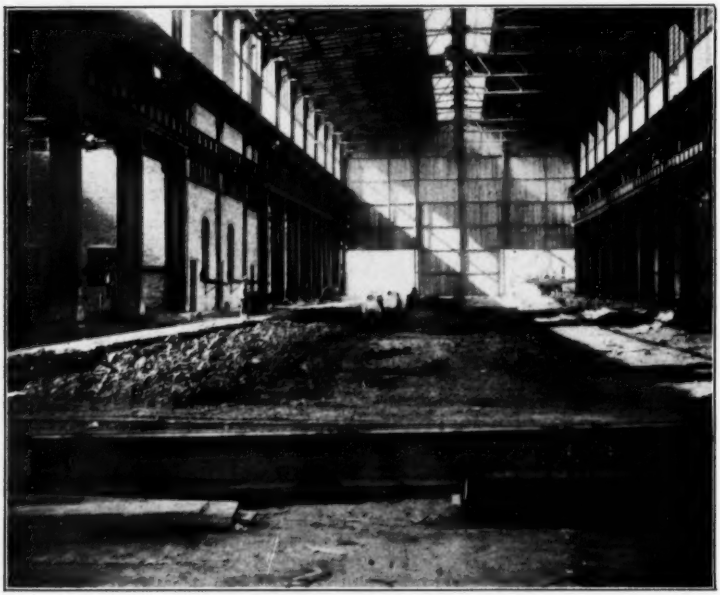


DISINTEGRATOR FOR FOUNDRY USE.
Christy & Norris, Chelmsford.

Disintegrators are more and more coming into use for pulverising and reducing to powder all kinds of materials, and with these coal dust may be produced to any degree of fineness. Pan mills are also used for grinding coal dust, but the product is suited only for castings where smoothness of skin is not a first requirement. Owing to its coarseness, the coal dust produced in pan mills is quite unsuitable for light castings, unless after an excessive amount of milling and waste of time and power.

Facing Sand.—Every moulding sand consists primarily of silica with small percentages of oxide of iron, alumina, and silicate of alumina, or clay, as the materials which bind the particles of silica together. Sometimes, but not often, there may be no oxide of iron present in the moulding sand.

Water is present as "combined water" even when sand is considered to be dry. Sand is called "burnt" when this combined water has been driven off by the action of heat. Added water will not produce "bond" unless combined water be present. Lime must be practically absent as it increases the fusibility of the sand.



EXCAVATING THE FLOOR TO BE FILLED WITH MOULDING SAND, WEST ALLIS FOUNDRY OF THE ALLIS-CHALMERS CO.

SAND-MIXING AND CORE ROOM, DEUTSCHE NILES-WERKZEUGMASCHINEN-FABRIK, BERLIN.

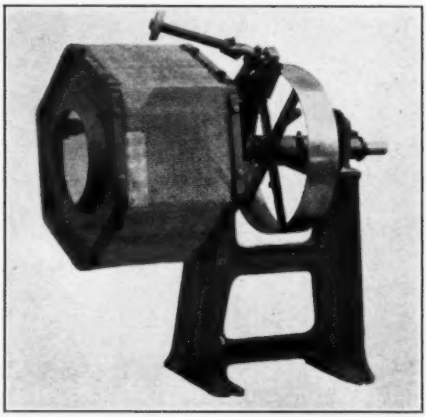
MOULDING SANDS.

	Mansfield Sand. Per cent.	Erith or London Sand. Per Cent.	S. Staffordshire Sand. Per Cent.
Silica	94.02	87.86	93.40
Alumina	3.73	5.04	4.06
Oxide of Iron	2.07	4.28	2.14
Lime	——	0.30	——
Loss on ignition	——	2.41	——
	99.82	99.89	99.60
Clayed matter removable by washing	4.70	——	4.90

These may be taken as examples of good moulding sands, the London sand being yellow, the other two red.

Beyond the analysis, the suitability of a sand for particular moulding purposes depends largely on the state of subdivision of the particles or grains of silica. If these are large, the sand may be suitable for heavy work, but certainly not for small castings, unless with a considerable preliminary mechanical treatment.

In considering the most suitable treatment to produce the best moulding sand we have to take into account the sand available and also the class of castings for which the sand is to be used. Moulding



EBERHARDT'S AUTOMATIC SAND SIFTER.

sand for dry-sand and heavy green-sand work may be mixed simply by shovelling and riddling, as the surface of the mould is usually black-washed or blacked and sleeked. The granular formation of sand which has not been rolled or milled allows of a freer use of water than is the case with milled sand. Where the proper proportion of clay is present in the sand, hand mixing makes a better sand for heavy castings than milling will. If the clayey matter be deficient, then milling will improve it by more thorough distribution of the clay and bonding materials. For light castings and castings of an intricate character milled sand is a necessity. For ornamental castings and fine figure work, in some cases the sand after milling is taken in small quantities, formed into a ridge, and rolled or brayed by means of a roller held in the two hands. This rolling makes it of a consistency and fineness such as no other treatment produces.

The milling or rolling of sand has the effect of reducing the grains of silica to a greater degree of fineness. Seen under the microscope, such grains have largely lost their angular structure and have a flattened appearance. In short, the reduction in size and the flattening of the grains of silica, together with the thorough admixture of the clayey matter, gives milled sand its "tough" quality and degree of fineness. It follows as a consequence that for fine castings, simple mixing by hand, or

CENTRIFUGAL SAND-MIXING MACHINE.
Wm. Sellers & Co., Phila., Pa.

by machines of the centrifugal type, is permissible only if the sand be by nature of a finely granular character, and even then it will not equal sand which has been milled or rolled.

Mixing the Facing Sand.—The new moulding sand is dried on an iron plated floor having flues underneath, and is allowed to cool previous to being put into the pan mill. Hot facing, like any other hot sand, sticks to the pattern by having some of the water vapour condense on the pattern. The drying of the sand is simply for the purpose of preventing the sand caking during the milling. Dried sand in a fast-

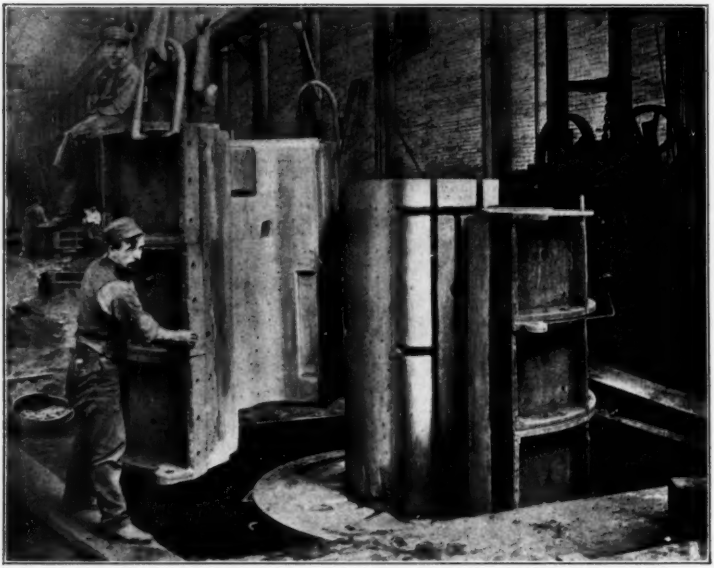
HEAVY WORK IN THE SOUTH FOUNDRY OF THE ALIS-CHALMERS CO., MILWAUKEE, WIS.

moving mill has more the appearance of a fluid than of a solid. The result is a thorough mixture of the sand and the added coal dust. Taken from the mill, the sand is damped, riddled, and sieved, and is now ready for work.

In the mixtures of facing sand which are given the coal dust is made from bituminous coal containing 14 per cent. ash. This is coal of fairly good quality.

FACING SAND FOR HEAVY AND MEDIUM GREEN-SAND CASTINGS.

New moulding sand.....	10½	parts	or	60	per	cent.
Black sand from moulding floor.....	3	"	"	17	"	"
Coal dust	4	"	"	23	"	"



CORE AND MOULD FOR LOW-PRESSURE CROSS-HEAD GUIDE OF A LARGE ENGINE, FOUNDRY OF THE WESTINGHOUSE MACHINE CO., PITTSBURG, PA.

FACING SAND FOR LIGHT CASTINGS.

New moulding sand	14 parts	64 per cent.
Black sand from moulding floor	4 "	18 " "
Coal dust	4 "	18 " "
(Percentages are approximate only).		100

If the coal dust be rich the quantity used may be lessened, and this may also be done where skin drying is employed, or if heavy coats of blacking are dusted on the mould and are then sleeked or smoothed. These mixtures are given only as examples of first-class facing sands and may be varied as required for particular applications.

The facing sand used in Falkirk district, noted for fine castings and ornamental work, is made up of:

Erith or London sand	56 parts	67.00 per cent.
Black sand from the moulding floor	14 "	16.50 " "
Coal dust	14 "	16.50 " "
(Percentages approximate only.)		100.00

The Erith or London sand is dried and thoroughly incorporated with the black sand and the coal dust by means of the pan mill. For intricate drawbacks the sand is in addition rolled by hand or "brayed"

as already mentioned. No blacking is put on these moulds. For heavy castings the black sand is largely increased, the coal dust decreased, milling is not employed, and the moulds are blacked and sleeked.

Blackings or Facings.—These are used on the face of the mould only, charcoal made from wood being used on green-sand moulds, "patent" or mineral blacking on dry-sand and loam moulds. Plumbago is sometimes used by itself, but mostly as an aid to the charcoal and mineral blackings to give a fine skin to the castings.

With a ball mill of a very modest size, charcoal blacking sufficient for a large foundry may be readily and cheaply made. Charcoal blacking made from the heavier woods is best, as the liability is reduced of such blacking washing before the metal. It is to be remembered that blacking which washes away and rises with the metal appears as so much dirt in the casting. A little plumbago dusted on the top of the charcoal blacking and the two sleeked in together gives weight and body to the facing, helps to prevent washing, and improves the skin of the casting.

"Patent" or mineral blacking is made from the residual carbon obtained from the retorts used in distilling shales or earths containing oils, and also from ordinary gas-work retorts. This carbon is exceedingly hard, of high specific gravity, and requires special machinery for its production. As a coating for loam and dry-sand moulds it is unequalled. It is mixed with clay water of the consistency of a thick cream and is put on the mould by means of a swab or a brush. If plumbago be added the skin of the casting is made to have a lighter colour. It is more economical to dust the dry plumbago on the top of the newly black-washed mould. The plumbago is on the surface, where it is wanted, and it also facilitates sleeking of the black wash. The sleeking of the black wash on loam moulds is much less practiced than formerly. A camel's-hair brush is used to remove all inequalities on the surface of the black wash and is used wet. A little plumbago in the water used with the camel's-hair brush, helps the appearance of the casting. When finishing is done by means of the camel's-hair brush no loose plumbago is dusted onto the mould. It should be seen that the plumbago is of good quality. Owing to its high price it is subject to much adulteration. How to judge its quality and purity will be shewn in the next paper.

COST-FINDING METHODS FOR MODERATE-SIZED SHOPS.

COSTING AND TRACING AT THE COTTRELL PRINTING-PRESS FACTORY.

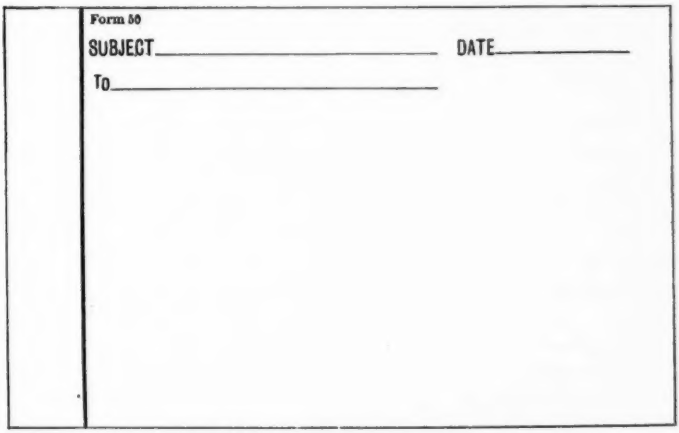
By Horace L. Arnold.

The series of articles of which this is the third began in December with an account of a system in use in a well-managed boiler shop. Last month the example taken was a machine-tool building works using the premium plan. Next month's paper will be by William Magrutor, and will give the methods of an engine-building company in the southern States. The purpose of every article is to furnish a working description of a practical system, in actual use in a shop where it has stood the test of time and proved sufficient, and with it to give fac-simile reproductions of all forms and blanks. This makes the papers particularly useful to those concerned with shop accounting.—THE EDITORS.

THE printing-press factory of the C. B. Cottrell and Sons Company, at Westerley, Rhode Island, employs 450 hands. The factory, for the purposes of this article, comprises the factory offices, the machine shop, the forge shop, and the foundry; the factory officials chiefly instrumental in production and costing are the general manager, head of the "Department of Production" (herein designated the "head"), the machine-shop superintendent, the production-order clerk, who makes the sub-production orders, the transfer and tracing clerk, the stores keeper, the forge and foundry clerk, the foundry foreman, the smithy foreman, and the cost clerk.

The following terms will be used;—Principal Production Order, meaning an order for the factory to produce an entire construction, as a printing press; Sub-production Order, calling for a single component or one lot of single components; Repairs Production Order, and the Stores Replenishment Production Order, styled "S K" production order. There is a fourth form of minor production order, used to meet the case of compound components, where several simple elements are finally united to make up a single structure.

The Principal Production Order.—All production orders emanate from the head of the department of production. This principal production order is made by the head on Form 1, general factory correspondence, which see, and consists of the date, the number of production wanted, the production symbol, and the vivifying signature of the head in the lower right-hand corner. These forms are type-written, and



FORM I. DEPARTMENTAL CORRESPONDENCE.
Original is about 8 by 5 inches, printed and ruled in black on white paper.

are brief. Thus "6 12K Presses" is all the product specification needed to cause the factory to begin the construction of six complete 12K printing presses.

Nine copies of each principal production order are made in carbon, two going to the production-order clerk, who files one in his own file and the other in a file which he keeps, but which belongs to the head; one goes to the machine-shop superintendent, and one each to the purchase agent, the route clerk, who selects lines of transportation for shipments, the stores keeper, the foundry foreman, the forge and foundry clerk, and the transfer clerk.

The principal production order may call for several thousand single component productions, as determined and specified by the "Lists."

The Machine Shop Superintendent.—Principal production orders go to the machine-shop superintendent, with notification of shipment date, which is expected to be promptly met. The transfer clerk fills many of the duties of assistant to the machine-shop superintendent, and gives out all the work. The superintendent has general charge of work in progress, and directs the sequence of operations with a view of meeting shipment dates. The superintendent has copies of all lists, and his efforts are directed principally to forwarding operations on components so that they shall be delivered to the erecting floors when needed there.

LIST OF PARTS

NEW PRESSES. **K**

	SUB. NO.	NAME OF PART	
		CASTINGS.	
	1	1 Side Frame-Right,	
	2	1 " " Left.	
	2½	1 Rear Tie,	
	3	1 Base,	
	3½	1 Front Tie,	
	4	1 Track,	
○	5	2 Track Supports,	
	6	2 " "	
	6½	1 " "	
	7	3 " "	
	7½	4 " "	
	8	1 Yoke,	S.K.
	9	1 " Box, 2 pieces,	"
	9½	1 " " Cap,	"
	10	1 Outrigger Base,	"
	11	1 " Stand,	"
	12	2 Slider Gear Shield,	"
	13	1 K. Shaft Bearing,	
	14	2 Long Track Support,	
	15	1 Cam Conn. Collar,	S.K.
	16	1 Rackhanger,	
	17	2 Air Chambers,	
○	18	1 Rack Guide,	S.K.
	18½	1 " Cap,	"
	19	1 Rocker Shaft,	"
	20	1 Bed,	
	21	1 Ink Table,	
	22	2 Toggles,	S.K.
	23	1 Cam Connection,	"
	23½	1 Vib. Cam Collar,	"
	24	2 Rocker Shaft-Boxes,	"
	24½	4 " " Caps,	"
		Carried forward,	

FORM 2. PRINCIPAL-ORDER COMPONENT LIST. "CASTINGS" FORM. FORGINGS FORM IS SIMILAR. BOUND DETACHABLY IN BOOKS.
Original is 4 by 10 inches, ruled in red and blue on white paper.

Lists.—The lists originate in the drawing room, and are of two sorts, same general appearance, "Castings" lists, and "Forgings" lists. Every component not a casting is constructively a forging, and is listed in the forgings list, whether really a forging or not. These lists are printed (see Form 2) and are detachably bound in books with substantial stiff covers, and are absolutely complete for each regular construction. Since all the foremen and the stores-keeper and purchase agent each have principal construction-order copies, the factory may at once begin the detail work of producing the needful components. The purchase agent knows what is to be bought from outside sources and the foundryman and the smithy may begin the production of castings and forgings.

Casting Production on Principal Production Orders.—The foundry foreman has a copy of each principal production order. He also has printed lists of the castings for the order. Besides this printed list, the foundry fore-

man has cabinets of trays, one tray inscribed with the symbol of each regular production. These trays have card grooves with the list numbers and symbols, in which cards stand upright, bearing the corresponding symbols, one card for each individual piece of casting in the principal production. According to work in progress, the foundryman selects patterns and begins the order filling, turning each card with its inscribed face to the rear as soon as the casting it calls for is done. When a pattern is given out in the foundry the number of castings called for by the order is made. Consequently, as soon as all the cards in one of the foundry cabinet trays have their faces turned to the rear, the foundry foreman knows he has made castings for the whole order.

As soon as a casting is made from any pattern, the foundry foreman notes the weight of the piece on the back of the card which bears on its face the corresponding piece symbol. This card stands in the similarly marked groove in the castings component tray, and its tray, in turn, is marked with the principal product symbol. This gives the foundryman a complete weight record of all components he ever made once, in such form as to be instantly available.

Drawings and Blue Prints.—Production begins of course in the drawing room, where the machines to be built are designed, and drawings are made of the complete press and of each single piece which goes to make up the whole.

Construction-drawing blue prints, side and end elevations, and such sectional elevations as are needful, go to the erection foremen, who alone have use for them, while books of quarter-size blue prints of all details of each particular press are made up and bound in the blueprint room, and these are supplied to the erectors, to the foremen of the factory departments, and to the stores room, where the interchangeable components are stored.

Forgings Production on Principal Orders.—The forge and foundry clerk has complete forgings and castings lists of every principal construction, and also has a copy of every principal production order. The foreman of the smithy has bound books of quarter-sheet size blue prints for all forging details of every principal order.

Upon receipt of the principal production order, the forge and foundry clerk selects the forgings card tray belonging to the ordered product; this tray has card grooves numbered to correspond with the components of the forging list, and each groove has the usual card standing in it, bearing the groove number. The forge and foundry clerk compares the cards with the groove numbers, sees that all grooves are filled

Order No.
Quantity.
Description of work.
Pattern.
To Section.

PRODUCTION ORDER
AND
TRANSFER CARD.

FORM 3. PRODUCTION ORDER AND TRACER. DIFFERENT COLORS FOR DIFFERENT PRODUCTIONS.

Original is same size; filled by production-order clerk, finally sent to transfer clerk and destroyed when the order is shipped. Form 5 is the same, but deep red and stamped S K. It takes the same course but goes finally to cost clerk.

with cards standing with symbols to front, and sends the tray to the foreman of the smithy, who proceeds with the forgings, using his book of blue-print details, of course, to produce the correct forms and sizes. This places the forgings in work. As fast as the forgings are completed in required numbers of each, the piece card in the tray is turned symbol to the back, and thus the foreman is informed by simply glancing at the tray when the order is completed.

The Production-Order Clerk.—The production-order clerk writes the sub-production order cards for all productions except the repairs and S K castings orders, which are written by the transfer clerk, as will be specified hereafter.

Principal production orders, made on Form 1, are sent to the production-order clerk, who by reference to his corresponding book lists of castings and forgings, proceeds to write the sub-production orders on Form 3, all printed alike, all of the same size, but of different colors for different varieties of presses. These sub-production orders have two functions;—first that of ordering production by the factory, and, second, that of "passport," or "transfer" card. This production order and transfer card is always kept in the same factory department with the piece it authorizes, from the time the component has tangible form until it is completed. No factory department or official will receive any component or material unaccompanied by this production order and transfer card. Consequently any piece without a transfer remains in the department where this lack is first discovered, and cannot be moved out of this department until its whole story is known, and a new

transfer furnished it; then it again becomes mobile, and may proceed to its proper destination.

Having filled all the component production-order and tracing cards for both forgings and castings, the production-order clerk sends them to the transfer clerk, at the transfer desk, located about the middle of the machine-shop floors, where the transfer clerk holds them until ordered by the head to begin machine-shop operations on the order.

"S K and Repairs Production Orders.—A great number of parts "stock," or "S K," which go into every Cottrell printing press, are kept in the stores room, ready for use on the erecting floors. Upon receipt of a principal production order on Form 1, the stores keeper looks up his card inventory to see that he has the needful S K components ready to meet the requisitions which he knows will be made on his stores. By orders from the head of the department of product, each stores item has a maximum and minimum limit; the stores keeper replenishes his stores by filling Form 4, in carbon duplicate, and sending both original and duplicate to the production-order clerk, who makes the production orders on S K production-order and transfer cards. These cards are printed the same as Form 3, but are of a different color, and have a rub-

S. K. No. _____

Section _____ Storeroom _____

_____ Date _____ 190

Requisition for _____ Order No. _____ for

Quantity in Stock.

Storekeeper.

FORM 4. STORES-REPLENISHMENT REQUISITION.

Original is about 6 by 4 inches; filled in duplicate by stores keeper and both copies sent to production-order clerk. He makes corresponding S K order and tracer and sends them to transfer clerk, who fills out Form 9 for either forgings or castings and sends one copy of Form 4 to stores keeper and one to machine-shop superintendent. This latter also goes finally to stores keeper, who destroys both copies after he has received and recorded the components demanded by the form.

Production Order No.	To Section No.	Date of Order
Please execute the following order, returning the order on completion of the work to the office. Charge all labor and material to the above production order number.		
Description of material to be used		
Quantity		
TRANSFER DATE		
Check Dept. No. when Article enters	SK	
To be Completed Form 6	Date Completed Approved LIBRARY BUREAU A 72310 C B. COTTRELL & SONS CO. Supt.	

FORM 7. FRONT. SPECIAL OR REPAIR PRODUCTION ORDER.

Original order is 6 by 4 inches, ruled in red and blue on a yellow card. Form 8 is identical, but thinner. Form 7 is filled in carbon duplicate by production-order clerk when filling Form 8. 8—the original—is sent to transfer clerk, who makes needful production orders on Forms 3 and sends them to forge and foundry clerk. 7—the duplicate—goes to cost keeper. Finally, the transfer clerk sends Form 8 also to the cost keeper.

No. Material	Price	Value	Date	Labor	Section	Hours	Value
				Factory Expense @			
Total Material				Total Labor and Factory Exp.			
Approved				Aggregate			

FORM 7. BACK. CONTAINING COST AND DATE SPACES.

ber stamp S K impression at the top. With each S K order an S K tracer is made, a stiff white card, about 2½ by 1½ inches bearing the rubber-stamp impression "S K". The S K orders and S K tracers are placed together, held with rubber bands, and sent to the transfer clerk. The production-order numbers are written on Form 4 and duplicate by the production-order clerk, and both are sent with the S K cards and tracers to the transfer clerk.

There are a great many "Repair" orders to be filled. If possible, these are filled from the stores room. If not in stock, then the production-order clerk makes production-order cards on Form 3, marked "R" at the head, and fills tracers for them with order number and component symbol as with the orders on Form 3, puts them together, and sends them to the transfer clerk as before.

There are certain compound components, made up of two or more pieces, which are listed in the assembled form as one single component. There are also miscellaneous orders for a few pieces only. All such orders are made by the production-order clerk on Form 7, with carbon duplicate, and by him sent to the transfer desk.

Shop Messages.—Every official's desk has two baskets standing on it, one "out," one "in." There is also telephone communication where needed. Written communications are made on Form 1, placed in the "out" basket, and taken thence by a constantly travelling messenger boy, who covers a fixed route in the factory, and placed in the "in" basket on the desk of the official addressed. These baskets, the telephone, and the messenger boy, make communication between department heads easy and rapid. The "cross" form of the factory floors makes a radius of 200 feet from the transfer desk cover the machine-shop plant, so that the transfer clerk can easily reach any factory-department head he wishes to see in person. Quick and easy communication between department heads is of the first importance in factory management, and the single-floor cross plan for the machine shop greatly aids ready intercourse of officials.

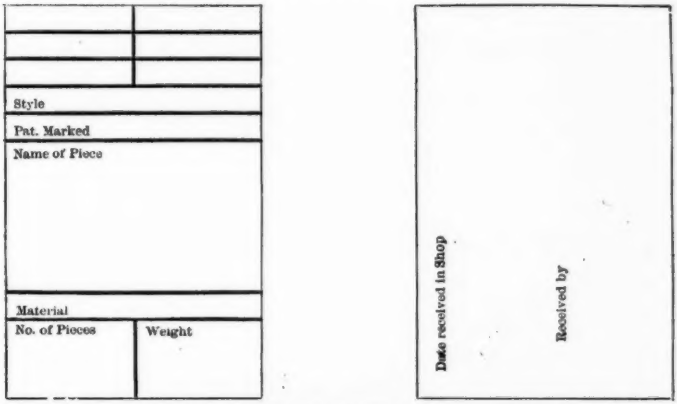
The Grooved Card Trays.—Wooden trays having rows of grooves made by saw cuts, or rows of pockets made by partitions, may be said to be the dominating conception and factor of the Cottrell shop procedure. These tray grooves are about half an inch, or in some cases more, in depth, and vary in width, and are thus adapted to take the stiff production-order cards standing on their edges, and hold these cards upright. The cards held by these trays are made to give information of varied character to the officials. In the foundry foreman's office the trays are fitted to slide in large cabinets, and each tray has card-

retaining and supporting grooves to hold the entire lot of cards representing the complete list of castings for one principal order. The smithy foreman has similar trays, each holding all the forging cards for one principal construction order. Each card and each groove of the forge and foundry trays bears the component number and symbol or pattern symbol, and these cards are permanent, and are only renewed when illegible from repeated handling.

The erection foremen have large card trays with numbered grooves, in which they place the component production-order cards as fast as the components are received on their own erection floor. A glance at the tray shows what has been received, and what is yet lacking. In whatever department a component rests, there is its production-order and tracing card with it, up to the time of delivery to the stores room, the "waiting" stores, or the shipping department.

The Transfer Clerk.—The transfer clerk has one assistant at the desk, and one laborer, who acts as special messenger and hand truckman. The transfer clerk must be familiar with all the tools in the plant, and must know the powers of the workmen as well, because it is one of his duties to place all orders in work for each departmental operation. Another duty of the transfer clerk is to note the transfer of each component in process of production, first from the foundry, the cutting-off room (which supplies cut rods and shafting), or from the smithy, to the machine-shop first-operation department, and then through successive factory departments to the erecting floors or shipping room, by means of written records made on Form 10 for principal-order sub-productions, or on Form 8* for compound component and miscellaneous minor-production orders, or on the S K tracer. The exact routine of component working and tracing is this: The transfer clerk sends the rough component with its production order to a "section," or machine-shop department, foreman; the foreman gives the piece, with its production order, to a workman; the workman places the production order in a small tin hanging card receiver, made for the purpose, and secured in any convenient place—at the end of his bench, or on his stool, or anywhere near at hand. Lathe hands very commonly hang these card holders on their belt-shipper handles. When the workman has completed his operation he records the time on his time card, and returns the component and time card to his foreman. Each foreman has a laborer called a "trucker," who takes the production orders to the transfer clerk, who notes the date on his tracing record, with the new department number, and directs the trucker, who

* See description under Form 7, page 720.



FORM 9. CASTINGS AND FORGINGS MATERIAL ORDER. FRONT AND BACK. Original is 2½ by 3¾ inches, stiff card. Filled by transfer clerk from principal order lists; sent to foundry and forge clerk on orders written on Form 1; returned with weight record to transfer desk; date on back is filled by transfer clerk, and receipt by forge and foundry clerk.

then delivers the component and its production order to the foreman of the next operation department.

The transfer clerk must be familiar with the principal factory productions, and must be able to recognize their components on sight. These requirements compel the selection of the transfer clerk from the factory machinists of long experience. No special clerical training is needed. Quick perception, familiarity with factory product, and coolness and strict attention to routine, are the special qualifications which the transfer clerk must have, and he must also be able to make dates in small plain figures.

The Transfer Clerk's Desk.—This desk has ample room for two writers, standing height, with two high chairs. The top of the desk has two baskets, as usual, and a "waiting" card rack for sub-production orders not in work, a card indexed waiting tray in which Forms 8 are held during work, ink stands, pencil racks, etc. The desk has drawers to contain paper-covered, brass-fastener-secured books of Form 10, on which the component locations of principal orders are traced. Back of the chairs is a narrow railed-in space. The front of the desk is open to the shop floor, next the rail stands a "Tracer" cabinet, for holding the S K tracers, having as many grooved tray drawers as there are factory departments, each bearing on its front the department name.

All regular production orders go to the transfer clerk. Repairs and S K orders are put in work without further instructions, the S K

CASTINGS

No.	NAME	Number Wanted	PAT. MARK	SECTION NUMBERS	DATE FINISHED
1	Side frame. R.				
2	" " L.				
2½	Rear tie.				
3	Base.				
3½	Front tie.				
4	Track.				
4½	End piece.				
4½	" "				
5	Track support.				
6	" "				
6½	" "				
7	" "				
7½	" "				
8	Yoke.				
9	" box.				
9½	" " cap.				
13	Inside kn ickle shaft bear.				
14	Track supports.				
14½	Bed rolls.				
15	Bed roll stands.				
15½	" " oil pan.				
16	Rack hanger.				
17	Air chamber.				
19	Rocker shaft.				
20	Bed.				
21	Ink table.				
23	Cam. cone.,				
24	Rocker shaft boxes.				
26	Track caps.				
27	Sliders.				
28	Gibs.				
29	Gib supports.				
32	Feed guide brackets. R				
33	" " " L				
34	Vib. rack shield.				
35	Cylinder.				
36	Cylinder shaft boxes.				
37½	" " caps.				
38	Lifting shaft collars.				
39	Rack hanger guide.				
41	Middle bear.,				
42	Bed shield.				
43	" "				
50	Feed table bracket. R				
51	" " " L				
52	" " standard. R				

FORM IO. PRINCIPAL ORDER TRACING AND LOCATING FORM.

Original is about 8 by 10 inches, ruled in red and blue. Kept in paper covers by transfer clerk, who records dates of movement of principal order components in "Section" number spaces. Finally sent to cost clerk. There is a similar form for forgings.

Order No.	To Department Foreman	Date 190
Quantity	Description	Value
	Entered on Stores Ledger	
Delivered	Received by	

C. B. COTTRELL & SONS CO. MATERIAL DELIVERED CARD.

FORM 11. GENERAL DEPARTMENTAL STORES REQUISITION.

Original is 6 by 4 inches, printed and ruled in black on yellow paper. Honored by stores keeper, who fills value space if known to him; from him the card goes to cost clerk, who obtains other values from purchasing agent.

tracers being dated and placed in the first-operation department-tray grooves when the first operation begins.

Principal production orders are received by the transfer clerk when issued, and corresponding sub-production orders come to him as soon as filled by the production-order clerk, and are held until the order to put them in work is received, at which time the castings and forgings are supposed to be ready for machine work. The transfer clerk has already made out castings orders on Forms 9, which see, and now sends the castings and forging orders to the forge and foundry clerk, who marks the weight of each component on its sub-production order, and also notes the weight and symbol and order number on the daily list sheet of forgings or castings weights. Then the forgings and castings and their sub-orders go back to the transfer clerk who orders them delivered to their respective first-operation departments, and notes date of department entry on the Forms 10 sheet.

Tracing.—There are commonly about forty presses on the erecting floors, and it is the expectation to ship a press out of the factory every day. A single press may be made up of anywhere from 1,000 to 5,000 or 6,000 different components, which are carried through the factory in lots from 100 to 500 or 1,000, and there are always 10,000 or 15,000 lots of these components in process of production in the factory.

MAN NO.	SECTION NO. 8	DATE 190	OPERATIONS
NAME		ORDER NUMBER	Lathe Work
			Bench Work
			Drilling
QUANTITY	DESCRIPTION OF WORK	HOURS / MIN.	Boring
			Sawing
			Reaming
			Splining
			Bolt Cutting
			Cam Milling
			Surface Grinding
OPERATION			Tapping
			Polishing
			Cutting Off
6 ½ 7 ½ 8 ½ 9 ½ 0 ½ 11 ½ 12			
X ½ 1 ½ 2 ½ 3 ½ 4 ½ 5 ½ 6			
			DAY
TIME / PIECE	APPROVAL M. P. FOSTER. SERVICE CARD	HOURS / RATE	VALUE

FORM 12. TIME CARD. DIFFERENT COLORS AND LISTS FOR DIFFERENT DEPARTMENTS.

Original is 6 by 4 inches. Printed and ruled in black on brown paper. Filled by workman and vised by foreman. Goes to paymaster and then to accountant.

It is absolutely necessary that three things should be always known of each individual factory production, great or small, simple or compound:—First, under what production order the component is produced, second, where the component is at any instant, third, what the state of progress is; this in regard to individual productions. In regard to principal productions, it is needful to know what components of each are completed, and in what state of progress the incomplete components are at any instant of inquiry.

No human mind could possibly remember the location of each one of the great number of components on the various department floors of the Cottrell shops, much less repeat correctly all of its time and location records, yet it is absolutely needful that all information in regard to every piece for which the head has called upon the factory, shall be accurately recorded from the time when its existence as a factory product begins.

S K Production-Order and Transfer Card and the Corresponding Tracer Handling.—The lack of the production order and transfer arrests a vagrant piece; consequently no unauthorized production is possible. It remains to locate the production by use of the tracer. When any department operations on any component are completed, the component must go to another department, to the erecting floor, to the stores room, or to the shipping department. It may of course

remain where it is, but the department foreman must tell how he came to have it. The transfer clerk directs all movements of pieces of material in process of finishing from one department to another. When a piece is to change its location its transfer card must go to the transfer desk, where the transfer clerk directs its next location, and when a component changes location, this change is noted by the trans-

COST STATEMENT

NEW PRESSES K

SUB. NO	NAME OF PART	ORDER NO. COST	ORDER NO. COST	ORDER NO. COST	ORDER NO. COST	ORDER NO. COST	ORDER NO. COST	ORDER NO. COST
	CASTINGS							
1	1 Side Frame--Right,							
2	1 " " Left,							
2½	1 Rear Tie,							
3	1 Base,							
3½	1 Front Tie,							
4	1 Track,							
5	2 Track Supports,							
6	2 " "							
6½	1 " "							
7	3 " "							
7½	4 " "							
8	1 Yoke, S.K.							
9	1 " Box, 2 pieces, "							
9½	1 " " Cap, "							
10	1 Outrigger Base, "							
11	1 " Stand, "							
12	2 Slider Gear Shield, "							
13	1 K. Shaft Bearing,							
14	2 Long Track Support,							
15	1 Cam Conn. Collar, S.K.							
16	1 Rackhanger,							
17	2 Air Chambers,							
18	1 Rack Guide, S.K.							
18½	1 " Cap, "							
19	1 Rocker Shaft, "							
20	1 Bed,							
21	1 Ink Table,							
22	2 Toggles, S.K.							
23	1 Cam Connection, "							
23½	1 Vib. Cam Collar, "							
24	2 Rocker Shaft Boxes, "							
24½	4 " " Caps, "							
	Carried forward,							

FORM 13. PRINCIPAL ORDER COMPONENT COSTS.

Original is about 8 by 10 inches, printed in black and ruled in red and blue on white paper. Margin perforated for binding. Similar list for forgings. Successive production costs shown on same line. Filled by cost keeper from Forms 7 and 14.

Quantity	No. of Piece	Name of Piece									
Size and Kind						Labor					
Order No.		Date									
	Material										
Total Material											
Total Labor and Factory Expense											
Aggregate					Factory ex. @		%				
C. B. COTTRELL & SONS CO. COST CARD A											

FORM 14. SPECIAL ORDER COST-SUMMARY CARD.

Original is 5 by 3 inches, printed in black, ruled in black and blue, on a white card. Filled by cost keeper and filed by him.

fer clerk on the corresponding tracer by noting on its back in pencil the date of transfer, and the location change is noted by moving the tracer from the last department tray occupied to the tray representing the department to which the component is to be taken. The front of the tracer bears the same order number and component symbol borne by the corresponding combined production-order and transfer card. Because no transfer can be made save by authority of the transfer clerk, he is always promptly informed of the completion of department operations on any piece in work. Hence the tracer tells all that need be known of the travels of the component, and as the transfer clerk must be familiar with all the work done, the department location and the date enable him to tell correctly the stage of finishing reached by the order.

Form 10 gives the department location and consequent state of progress of any component of a principal production order, and by means of this form or the tracers in the department tray cabinet, the transfer clerk can at any instant tell the present location and stage of progress of any piece in work, and the general condition as to forwardness of any principal order as a whole.

Both the production-order clerk and the transfer clerk are machinists, who had ten years' experience as factory workmen before they took their present positions.

THE MANAGEMENT OF METALLIFEROUS MINES.

By Albert Williams, Jr.

Mr. Williams has already reviewed the various widely differing kinds of metal mining and summarized suggestions as to a line of general policy applicable to the majority of cases. In this article he compares systems of organization and discusses the relations of the business and technical ends. A concluding section will take up in detail the efficient organization of the technical staff.—The Editors.

N discussing the management of metalliferous mines it is assumed that there is something to manage; that is, that the mine has been found and partially or largely developed, that the property is of sufficient importance to warrant the employment of a considerable force, and that its business as a producer or prospective producer of ore and as a consumer of labor and supplies call for real management. In short, an establishment comparable with a factory, shop, or mill. What then should be the scheme of organization to secure greatest efficiency and smoothness of running?

To begin with, at the top is the owner, who may be an individual, a firm, a close corporation, or a stock company with shares variously held. In any event here is the source of authority, whether a person or a board of directors, standing over the actual superintendent, selecting him, and in a general way directing him, and deciding upon the broad policy of the undertaking. This central power may have been guided by the advice of a consulting engineer as to the purchase and outline plan of developing the property; but when once the enterprise is fairly under way it is better that the ownership should deal directly with the superintendent, and if it is found advisable to call in an outside specialist for an emergency the latter should assist, not interfere with, the superintendent, who must be supposed to be competent within inevitable limitation.

The question of the commercial policy of a mining enterprise need not be gone into in detail here, since it concerns the main office rather than that of the local manager; but it may be remarked that once decided upon it may strongly affect the technical running of the mine. The factors, in brief, which influence the decision are the state of the

market, ore product and supplies, the transportation facilities (and season), the labor situation, available funds, etc. In gold mining there is of course no question as to marketing the product; with silver it depends upon the richness of the ore; but when it comes to the lower-priced products, such as copper, lead, zinc and more particularly iron ore, a great deal hinges upon the markets, the general condition of business in the country, and perhaps upon combinations to regulate or restrict output. All this should be made known to the superintendent, who is instructed to modify his scale of operations accordingly. The main office holding the purse strings also limits the superintendent's action, so that when working capital or reserve run short he may be forced to abandon some project which would be most desirable from the technical point of view and under other circumstances.

The proper relation of the home office to the superintendent is easily stated, is well understood and admitted—and is not always maintained in practice. In a board of directors there are likely to be one or more well-meaning, fussy persons who cannot restrain a desire to meddle with technical details of which they may have but a vague comprehension, and who evidence their zeal by frequent visits to the mine, where they make things pleasant by criticism and impracticable suggestions. The superintendent should be most carefully chosen, and when a good man has been secured he should be given a free hand as to details and especially as to his dealings with his subordinates, whether the staff or the men. Any other system is no system and is subversive of discipline. It would be like dropping a hammer head or piece of drill into a rock-breaker.

The home office should communicate freely and often, however, with the superintendent, giving him his instructions on broad lines, and it will be well if the relationship should be sufficiently confidential to enable the superintendent thoroughly to grasp the financial situation and to foresee and to provide for changes of policy. If he were always posted in advance as to matters of dividends, assessments, issues of bonds or new stock, amount of reserve and working capital, etc., he could act intelligently; but such confidence is too much to expect always.

Thus far the terms superintendent and manager have been used interchangeably. Strictly speaking, they are not synonyms, but are often loosely used as such. The American idea of a superintendent is the man on the spot who bosses the whole job, who attends both to the working of the mine and all its adjuncts (metallurgical, transportation, etc.) and to the business side as well. He is an evolution

from small beginnings, and under existing expansion is sometimes overweighted by his work. It would be highly advantageous if all the multifarious functions of a great establishment could be centered in a single head, and so far as is practicable this is usually done in the United States. It has been found expedient, however, sometimes to divide the responsibilities. The authority must be unimpaired. Thus at some mines in the United States, and at most British-owned mines elsewhere, there is a manager, agent, or managing director who attends to the local business and who outranks the man who actually runs the mine. The latter official then becomes a "mine captain," a sort of glorified foreman, and he is the one with the technical skill and experience. A dual headship, putting the two on equal rating, has been tried. It could hardly be expected to work. Now it is obviously a delicate relationship at the best between these two men, and a clear understanding and mutual forbearance are needed to maintain harmony; so that it is well that the final say should remain undisputed, to avoid a clash. There is nothing to prevent the agent or manager from being a true mining man, and, if so, so much the better; yet this is not indispensable. A wholesale confectioner has made a very good mine manager, and there are agents who do not go underground once in weeks or months, while the captain looks out for that end.

There is an alternative plan which is adopted at some mines. The superintendent—the miner—remains at the head, but has a trustworthy man who elsewhere would be called a business manager and who is a cross between purchasing agent, accountant, and secretary, and is given considerable latitude of action, thus allowing more time to the superintendent for directing the mining operations. This is practically a reversal of the previous plan, but retains the idea of single headship, and should work well wherever the mining problem is difficult or the business moderately extensive. One may be, and often is, an excellent miner without being a good business man. What is wanted is a definite adjustment of responsibility and authority.

The relation of the superintendent to the home office is reciprocal to that of the home office to him, as already explained. He usually makes a formal weekly report of the operations of the week just ended. This shows the following among other items:—tons of ore raised; tons of waste; tons of ore milled, concentrated, shipped, etc., as the case may be; average assays of ore mined and of ore shipped or otherwise treated; number of feet sunk or raised, feet of shaft, incline or winze timbered; feet driven; feet of levels, cross cuts, drifts, etc., timbered; assays from face of drifts, bottoms of mines, head of upraises,

breast of stopes, etc.; number of men employed in various departments; condition of the mine at all points; requisitions for money and supplies, etc. Part of this can be conveniently entered on printed forms; part will be written out succinctly and simply. If there is a metallurgical plant, its report (for which another set of forms might be prepared) is incorporated in the regular weekly statement. The business report is made up and forwarded monthly, and follows a set form in part, for convenience of comparison with former months and summarizing. This gives the pay-roll, receipts, expenditures (itemized and grouped) for salaries, labor, supplies, transportation, etc., together with explanations written out. This report should be in such shape as to fit in with the system of bookkeeping at the main office, and also to work readily into the quarterly and annual balance sheets. If the company publishes an annual report, the superintendent's annual summary is a leading feature, following the financial statement; it should show average costs, and is designed to make clear to the shareholders without unnecessary technicalities just what has been done at the mine and works during the year. Even with private ownership or that of a close corporation, these formal reports, however brief, are useful. Besides the regular statements the superintendent should promptly report emergencies and should always clearly explain the local situation, outlook, and requirements, making suggestions for future work needing approval, and when in doubt getting authority to carry plans into effect. For large mines telegraphic or long-distance telephone communication is a great convenience and time saver.

The relation of the superintendent to his subordinates should also be perfectly distinct and well understood on all sides. Only a mine of considerable importance can maintain an expert staff. If there is one, it may comprise an assistant superintendent, surveyor, metallurgist, assayer, electrician, machinist, surface and underground foremen, as the case may be. The superintendent should cultivate friendly relations with his junior officers and among themselves. In isolated camps they usually mess together and are all thrown into such intimate daily contact that good temper is worth having. The superintendent should maintain authority with the least friction and arbitrariness, and should encourage and be ready to approve and apply useful suggestions, interfering as little as possible with the details of their work. The amount of expert assistance which the superintendent or manager receives depends upon what the mine can afford rather than what he would like to have or might really need, for it would be

almost as absurd to overload the enterprise with a heavy salary roll at the mine as with one at the home office—not quite, though. Much rests upon the prosperity of the undertaking or the probability of making it prosperous, and upon the scale. It would be easy to eat up in salaries the margin of profit of a moderately successful mine.

Towards the hands, the relation of the superintendent is direct and personal at small and medium mines; at large ones he acts through his immediate subordinates, and in this case the order of authority and responsibility passes downward without interruption. Mine discipline is just as important as military discipline, but in its outward aspect is a very different matter. Nothing of the martinet is permissible in a mine superntendent or any other mine officer. Even a certain degree of familiarity is allowable without risk of relaxing rules, and American miners would resent any offishness. Orders should be given with considerateness, but enforced strictly, since prompt obedience is of prime importance in the ever-recurring sudden exigencies of mining. For infraction of rules there is only one penalty—discharge. Consequently the rules should be sensible, easily intelligible, as few and as little irritating as possible. Those designed to prevent or lessen the danger of accident are the ones upon which the most stress should be laid; and though the risks in metal mines differ in some respects from those in collieries (explosions of gas and dust being eliminated, also suffocating gases usually), they are scarcely less imminent and call for equal precaution.

While what has been termed the commercial policy of a mining enterprise must be determined by the owner or central office, subject to the fluctuations of the markets in some instances, and to available capital in all, much is left to the discretion of the superintendent or local manager in deciding upon a plan of campaign, to say nothing of measures which he may recommend but cannot carry into effect without authorization. In his advisory capacity he has to bear a large share of the responsibility for what is done, since the owner or directors necessarily rely upon his experience and skill; besides which, being on the ground, he is in a better position to realize the situation and is expected to formulate and submit plans for all important work.

This is not a treatise on the art of mining, but a few suggestions of general applicability may be in order.

For one thing, it must be remembered that prospecting never ends, or never should end, until the mine is fully explored or finally abandoned. It is assumed that before acquiring a property and starting serious work a certain amount of prospecting and development

has been done, enough at any rate to justify purchase of the ground and the opening of a mine. This preliminary work would be intended to serve as a guide for the laying out of the underground workings. But even after a shaft or shafts have been sunk or adits run, up to the time when the full extent of the territory has been explored underground, the surface prospecting should go on. Trenches and shallow pits, which are inexpensive, should be put in at rather close intervals along the line of outcrop (if there is one), and these may furnish clews to the location and direction of ore shoots which are then drifted for below ground. With bedded or segregated deposits the diamond drill, started most conveniently at the surface, may save much dead work below. Underground prospecting is perhaps the most important and the crucial test of mining. It is an art in itself, and the method followed is modified by geological and local conditions. In general, there are two main systems of underground exploration:—

(1) Blocking out the ground between levels and connecting them with raises or winzes at regular intervals, and running cross-cuts, also spaced, right and left on each level as far as probabilities warrant. These blocks of ground are usually spaced at intervals of 100 feet vertically and 200 feet in drifts, the purpose being not to miss any large ore body. Within these distances any feeders, stringers, or knife edges would almost certainly be caught.

(2) Following "indications," as for example, index seams along one wall or the other, small stringers and feeders of ore, traces of gangue minerals, iron stains, water channels, cross courses, etc.

The core drill is also available underground, but has not much range horizontally and on flat dips. At any rate the selection of ground for stoping should in large bodies be regulated by the results of this exploratory work. In small, irregular, and high-grade deposits, however, the usual plan is to follow the ore if there is any, Mexican fashion; and when the ore gives out, to follow whatever signs there are. This exploration should be kept well in advance of the process of extraction. Too much stress can hardly be laid upon the importance of constant sampling, assaying, and testing, whenever the face is in anything like ore, however poor. In this way the underground prospecting is guided, and of course the stoping.

It is impossible to say in short compass anything worth attention as to the exact plan of attack in starting new openings from the surface. Each case must be judged by itself. It may be remarked, however, that the trend of recent practice has been in favor of vertical shafts where formerly slopes (inclines) or tunnels would have been

preferred. Better hoisting machinery, cheaper fuel (where railroad connections have been made), and the advantage of bottoming a deposit and working from the deep, account in part for the change in opinion about what might have been mooted cases of shaft *versus* tunnel a few years ago, but the readier securing of capital in the present temper of investors has something to do with it; while as regards shaft *versus* slope the latter is now seldom adopted on very steep dips. In the earlier days of metal mining the permanent workings were usually extensions of preliminary prospecting pits and tunnels, but now it is a common thing to see a mine opened systematically from the outset, provided there is a known ore body or there is reason to believe from the "lay" of adjoining properties that one exists.

The selection of plant hinges upon the system of development. There is now no excuse for ordering the wrong *sort* of machinery to fit a given state of affairs, for in all lines (steam, compressed air, electric, or hydraulic) mining and metallurgical machinery has been brought to a pitch of efficiency which leaves little to be desired. The great difficulty is to gauge the proper *extent* of the plant, to get enough to do the work and not to overdo it. The conservative plan is to begin with moderation and allow for expansion later, even if some temporary apparatus has to be discarded; for example, to start sinking with a horse-whim or donkey engine, to plan mill buildings with a view to convenient extension, to make the first installation if possible a unit-group for later complete output, and in proportioning motive power to operating machines to give an overplus margin to the power end. Besides this, in determining the kind and extent of mechanical plant, the manager is guided by results of installations under conditions similar to those he is called upon to meet. In the present stage of progress there is less and less scope for originality and novelty of design, the field having been pretty well worked over, so that conservatism rather than experiment is the prevailing policy. All mining men will recall the case of a famous mine so rich that it seemed as though nothing could hurt it and a certain amount of monkeying with untried methods and machinery might possibly be excusable, which has spent some millions in showing its neighbors how not to do things; but the careful manager will make it a rule to allow some public-spirited establishment which can afford it to make these experiments first—and then profit by experience. This does not sound very enterprising, but the plan is at least safe. Once in a while a new problem comes up, the solution of which can be worked out and proved in the draughting room, but most of the substantial progress has been made by gradual

modifications and improvements in well-tried methods, startling innovations being rare. A manager gets no end of credit for a bold move which succeeds, but he is restrained by the risk of disappointment. Here is opportunity for the exercise of a nice balancing judgment in maintaining progressiveness and standing ready to adopt new methods with an open mind, without running into extravagance, and in steering a middle course between rashness on the one hand and old-fogyism on the other.

The manager has also to proportion the scale of operations and the labor roster to the kind of mine in hand. Some mines will not hold a large force; for even with many working faces there is not a wide enough ore body for regular stopes. Then there are large low-grade deposits which cannot possibly be made to pay if worked on a small scale, fixed charges using up what little margin there might be, besides self-evident disadvantages. In such cases the wholesale method is the only one practicable, but should be undertaken only after a thorough study of all the conditions.

In small mines it should be the aim of the superintendent to make what would otherwise be dead work pay for itself or reduce its cost, by utilizing the leaders, even if they run out into the "country." This, again, is the Mexican idea, as opposed to the engineering principle. For narrow, uncertain veins and segregated deposits it is right to block out the ground; for regular veins the other system is better.

Speed is often economy. Certain charges are continuous, such as salaries, pumping, interest on investment, deterioration of plant and timbering, etc. A point too often overlooked is that the ore itself should be regarded as so much idle capital, drawing no interest. So the sooner it is gotten out the better, even if it costs a little more per unit to rush extraction. A mine is an exhaustible quantity, and thus differs from an establishment which may be kept going indefinitely. Hence, if there is a given quantity of ore in the ground, provided there is a fair market, it is preferable to get it all out in a couple of years at a nominally higher unit cost than in twenty years.

The ore may be regarded as only one of the raw materials. Sometimes it is expedient to sacrifice close technical results in order to save in the direction of supplies and other cost items—a hard strain upon professional pride.

Everyone realizes the importance of keeping the dead work well ahead of the stopes and of blocking out and measuring, or at least locating, ore reserves, but for reasons of temporary expediency this is too seldom done. To insure steady running of the mill, if there is one,

or to maintain regular shipments, the ore dumps or bins should be kept up. Where transportation is shut off in winter the extraction of ore should go on, to accumulate a sufficient stock ready for the opening of the next season. Good mining reserves the backs for the last, for the period just prior to the mine's abandonment.

Finally, this inadequate review of a very complicated and perplexing theme leads up to the inquiry, What of the man who is to attend to all this? If one is too finnicky in cataloguing the requirements, only an angel—and an angel of wide experience—would fill the bill. As humanity never concentrates all the virtues in one individual, the best that can be expected is to obtain some at least of the needed attributes and avoid as many as may be of the drawbacks.

As to character and temperament, the manager or superintendent should be energetic, prompt in decision, self-reliant, watchful, ready of resource, conservative without being afraid of big undertakings, broad-minded, willing to learn, and should possess executive ability and have a knowledge of men and affairs. As to acquirements he should have a fair all-round comprehension of all the technical work involved. Mining, besides the "practical" side—to use a much abused term which generally means putting in shots, setting timbers, blacksmithing, and guessing at other things—rests upon economic geology, which in turn is based on mineralogy, lithology, physics, etc.; metallurgy is founded on chemistry and assaying, physics, and mineralogy. Then civil engineering (road and bridge building, etc.), surveying (surface and underground, transit, level, or compass and tape, and draughting) comes into play. Mechanical engineering (including steam, pneumatic, hydraulic and electrical engineering) is often a requisite. Then even his manner counts; it should combine business with tact. No one man has all these faculties but some seem exactly fitted for managing a particular kind of mine, others for a different sort, and a few (given sufficient time) would get along anywhere.

There is no longer a prejudice against the technical schools and "booklarnin'." The self-taught successful superintendents would have saved much of time and misdirected effort by a preliminary grounding, and in the end have become even better miners. But the young graduate of the mining school needs considerable experience and rubbing down before essaying the responsibilities of superintendence. He should begin as an assistant, as mine surveyor, assayer, or foreman of some department.

THE COMMERCIAL MANAGEMENT OF FACTORIES.

By Ian Andrews.

Mr. Arnold's article preceding is addressed especially to the shop manager. Mr. Andrews speaks more directly to the office manager, who deals with general policies and commercial affairs in which the shop costs are but one element, though a very important one. He takes the matter up at the point where the preceding writer leaves it. The paper following considers the managing director's relations to general works organisation. A following one will analyse his relations to cost reduction.—THE EDITORS.

IN this article I propose to deal more particularly with the commercial or financial aspect of the management of factories, as distinct from the practical side of manufacture—although, in a sense the one is as practical a subject as the other. I shall therefore aim to epitomise a few of the leading principles of successful management. For this purpose, the subject is viewed from the standpoint of the managing director, who, having efficient departmental managers and foremen devoting close attention to the best means of production, exercises a guiding control of the business generally.

Reference is made particularly to the manufacturing businesses of joint stock concerns, of which there are now so many; but the remarks apply generally to similar proprietary businesses, for the aim of both is a fair maximum of profit. We hear a good deal of the want of soul in business corporations, but it must be admitted that, having to satisfy a large body of shareholders, they have as great an incentive as private owners to proceed on sound economic lines.

The subject may be conveniently considered in the following order:—(1) Capital (2) Cost of production (3) Working expenses.

Capital.—The amount of capital employed should not exceed that safe minimum necessary for the efficient and economical working of the business, as superfluous capital can only entail loss of interest, if not more serious consequences.

Fixed capital, consisting of buildings, machinery, plant, etc., being subject to depreciation, should be written down periodically, and there should be no division of profits without first making a safe provision for this important item in regard to all wasting assets. All repairs and maintenance should be scrupulously charged to revenue, or against reserves previously created for the purpose.

The rate of depreciation will necessarily vary, according to circumstances in different and even in similar businesses, and, as deductions for depreciation are more or less estimates, it is wiser to err on the safe side than to make an insufficient provision.

The probable lifetime of each item of capital which is subject to deterioration is generally the basis of depreciation, although this is not always a safe one, even with former experience as a guide; this is especially true in the case of machinery.

There are many firms today using machinery of an antiquated type, the output capacity of which is only a fraction of that of modern labour-saving machinery: but because the normal lifetime of their plant has not been reached, they will not discard it, oblivious of, or indifferent to, the fact that their policy is "penny wise and pound foolish." They therefore continue to deduct say 5 or 10 per cent. per annum, but would find it infinitely more profitable to write off 100 per cent. from the book value (less its scrap value if it cannot be otherwise disposed of) and to instal modern plant forthwith. Many successful concerns, however, appreciate this fact, and will throw machinery on the scrap-heap, or sell it, long before its natural life has expired, simply because of its inefficiency as compared with later inventions.

Paper assets or "watered capital," such as goodwill and Suspense Accounts, should be most carefully scrutinised, as they very frequently account for the over capitalisation of a business and lead to disastrous results. Occasionally the price paid for the goodwill of a business may be allowed to stand in the balance sheet at the original figure, because of the permanent or increasing value of the business; but even then there should be a substantial periodical provision, in the shape of contributions from profits, to a special reserve fund, to meet any unexpected diminution in value. A reserve fund is usually established as a provision for the equalisation of dividends, but this in itself is insuffiicient, for when the time comes to draw on such reserve to make up a deficit in profits, it means that the goodwill is, for the time being at least, of less value; and should there be repeated recourse to the dividend reserve fund, the value of the goodwill as a matter of course automatically shrinks. If, when the goodwill figure was originally a fair value, such a provision is desirable, it is all the more necessary when too large a sum has been paid for it. In such a case, indeed, it is fallacious to maintain the original figure as an asset even though a reserve appears on the other side of the account. It should be written down to its true value without delay, even if it has to be extinguished, in which case the goodwill reserve would disappear.

Having created reserves for such contingencies and for others likely to arise, it becomes a question as to whether the money should be invested in the business, or outside of it in the shape of securities. Theoretically a reserve should be readily available for the purpose intended, and if likely to be required on short notice, it cannot safely be locked up in the company's own business. Not infrequently, however, reserve funds are more profitably employed inside the business than they could be outside. For example, money safely invested outside may not yield more than 3 per cent. per annum, while additional capital cannot usually be obtained except at a higher rate. In the case of debentures, 4 per cent. or 5 per cent. may have to be paid, while if the company has no further borrowing powers, additional capital raised by the issue of shares may absorb a larger rate for dividend. As to the investment of reserve, circumstances must guide particular cases; but whatever form of investment is adopted, the first consideration is to set aside a sufficient part of the profits in order to strengthen the business, so that it may have a good reputation with its customers, creditors, and the investing public; for nothing is more damaging to success than doubt as to a company's stability, even when it is selling an article for which there is a popular demand.

We now come to the consideration of stocks—raw and manufactured—which form a most important item in regard to capital; in a large concern having a multiplicity of goods the most constant supervision of this fluctuating asset is absolutely necessary.

In the first place, it is highly essential that adequate stocks be kept, so as to ensure prompt execution of orders. If a business has a reputation for quick dispatch, it will go far in the direction of maintaining the value of the goodwill. No dilatoriness in the execution of orders should be tolerated, and periodical lists of unexecuted orders, with explanations for delay, should be submitted to the manager for inspection, so that he may take the necessary steps to rectify matters before the customers are compelled to make complaints. And in this connection it may be said that overtime, although not generally profitable, should, if necessary, be resorted to in order to cope with arrears, rather than to give customers cause for dissatisfaction.

The mistake in regard to stock-keeping, however, not infrequently lies in having excess stocks, and it is in obviating this that a good store keeper has an opportunity of showing his value. General experience goes to prove that where there is a large variety of raw and manufactured goods, unless a complete system of stock keeping is adopted and carried out, overstocking almost certainly follows.

There should be, in the first instance, properly constructed departmental stores—preferably situated near the respective classes of workers using them, so as to minimise the cost of handling. In these stores there should be a specific place for everything, as by this means obsolete stocks are discovered and weeded out. Each compartment or bin should be numbered and labelled as to its contents; a reference index or catalogue should be available, and maximum and minimum stocks of each article should be determined in the light of past experience, due regard being given to any increasing demand and to the fact that when large quantities of small articles can be bought or produced at proportionately cheaper rates than small quantities, larger stocks of such articles may sometimes be judiciously allowed. A record of all store receipts and deliveries should be kept, so that the store keeper may always know the position of stocks and take steps to replenish them. Circumstances will determine how far it will pay to carry out such a system in small factories, but generally speaking, there can be no doubt of the advantages of as complete a system as possible, especially in large works. A test check should be made from time to time, in order to ascertain how far the stock keeper is following instructions, and the accounts when made up at the date of stock taking will show the result in the aggregate.

It is not enough to find that the amount of stock does not materially alter at the different dates of stock taking. The stock on hand on such occasions, should be worked out on the percentage principle, in some such manner as the following:—

Manufacturing account for the year ending .....

(EXAMPLE.)

By sales		£250,000
To stock from last account	£55,000	
" materials purchased	110,000	
" wages paid	95,000	
	£260,000	
Less stock on hand	65,000	£195,000
Gross manufacturing profit.....		£55,000

From such an account the following percentages would be deduced:—

Stock on hand (£65,000) is equal to

(1) 33 1/3 per cent. of the manufacturing cost (£195,000) of the year's turnover.

(2) 26 per cent. of the turnover.

From the first of these it would appear that the stock on hand is equal to four months' requirements (*i. e.*, 33 1-3 per cent. of twelve months) taking the stock as a whole. There may not be four months' stock of certain articles, while of others there may be sufficient for the requirements of a much longer period, but the figures show the average stock held. These figures are of course assumed without regard to due proportions, but as to this, all proportions must vary according to the nature and circumstances of the business. Those in charge are the best judges as to whether it is necessary to hold one, two, four or six months' stock, but quite apart from any opinion or knowledge on the subject, each year's comparative figures will be the best guide to a manager, who, having to rely on subordinates to some extent, may yet by his bird's-eye view discover what others fail to see.

It will be observed from the figures assumed, that during the financial year, the stock had increased by £10,000, or say 18 per cent. This on first sight might appear an alarming increase. If, however, the previous years' accounts were similarly analysed, the true position could be readily ascertained. If the business was a progressive one, the percentages might show that, although the aggregate of stock is considerable, its relation to turnover is quite satisfactory. If, however, stocks were found to bear an increasing relation to the cost of manufacture of the year's turnover, there would be a grave need to investigate fully the reasons for the upward tendency.

The percentage of stock on the year's turnover is also a useful figure for comparison, although in this case it may be affected by fluctuations in the selling price of the goods. In the case of businesses having branch establishments there is frequently a considerable amount of stock in excess of the amount which would be required, if the business was worked from one common centre, but as the object of branches is to secure local trade, which could not (to the same extent) be otherwise obtained, this excess may be unavoidable. Yet by judicious management, the departmental stocks can be minimised.

While on the question of stocks, it may be remarked that in pricing inventories of manufactured stock, only the bare cost of production should be taken, exclusive of any percentage for working expenses. It is sometimes argued that such stock could not have been produced without certain establishment charges being incurred, but it is difficult to maintain that such charges would have been materially lessened if the stock on hand had not been manufactured. In the event of the business being wound up, the cost of realising the stock on hand in the ordinary way of trade, would absorb further charges,

and even should the business be sold as a going concern, the stock would probably be taken at bare cost only, while if disposed of by forced sale, much less than cost would be realised.

Some factories having branches manufacture for and sell to their branches at a price which includes an assumed profit, or at least a margin for working expenses. This price is charged in order to show the comparative results of each branch, but when manufactured goods are debited to a branch at a price beyond cost, a fictitious profit is brought out if the branch should include any of such goods on hand at the advanced price in their stock inventory at the end of the year. The more satisfactory method is to charge all transfers at bare cost, and at the end of the year, to prepare a memorandum departmental Trading Account, supplemental to the ordinary Trading Account, in which an allowance for working expenses may be made.

Before leaving the question of capital, the item of patterns should be mentioned. In many businesses, patterns have to be made for special orders and may not be again required, in which case the cost is not a capital charge but a revenue one, being recovered in the selling price of the manufactured article. When, however, similar articles are being constantly reproduced from regular patterns, the cost of such patterns may be fairly charged to capital, but it should be liberally depreciated from time to time, to meet the heavy wear and tear on patterns and to provide against the possibility of their becoming obsolete before they are worn out.

In order to preserve the capital intact, buildings, machinery, plant and stocks, as also goods held in trust for which the manufacturer may be held responsible (such as goods received for repair, etc.), must of course be fully insured against the risk of fire. In the case of factories having a number of separate compartments or buildings, between which stocks are constantly passing to and fro, it is an expensive matter to insure the stock in each building for separate sums, because it is always desirable to have a margin on each for any possible increase that may arise during the year, especially as the inventory values forming the basis of insurance may not fully represent the value of stock at the busiest period of the year. These margins would amount in the aggregate to considerably more than would be sufficient as a margin if the whole stock was insured in one sum. To obviate this, however, the stock throughout the works can be insured for one sum, subject to the "average clause," which will in no event adversely affect the insured so long as the total stock is fully covered. Loss of profit from a temporary cessation of business through fire,

and the rent of temporary premises used while the buildings damaged by fire are being repaired, are also insurable interests.

Needless to say, fire insurance should be supplemented, by the employment of night and day watchmen. It is also desirable to have fire appliances throughout the works and to train a number of employees in their use.

While an inflated capital is an evil to be avoided, it will be evident that insufficient capital is also a source of danger and loss. The amount of liquid capital necessary will depend upon (among other things) the nature of the goods manufactured, the turnover and output, and the facilities for obtaining raw material on reasonable credit. When labour, requiring as it does ready money for wages, forms a considerable proportion of the cost of the manufactured article, the liquid capital required will be necessarily high, especially if the output be large; and as that output increases, further capital will be required to pay additional wages, and to provide larger stocks to keep pace with the increased demand.

The command of capital enables a manufacturer to buy to the best advantage, and consequently to undersell those who are compelled to buy on long credit. When, however, capital is limited, it may be advantageous for the purpose of buying at the lowest cash price to trade on borrowed money, to a limited extent—if the cost is not excessive and the arrangements for repayment are not such as would involve the borrower in sudden difficulties.

When manufacturers have no facilities for, or are averse to, borrowing, they may have recourse to bills of exchange, which will give them similar advantages at rather less cost, although the liability thereon will, in a sense, be greater, by their having to provide for the certain payment of their acceptances as they mature. With limited capital, bills, besides providing the means of reducing the cost of credit, are frequently serviceable, if indeed not really necessary, as when raw material or goods have to be paid for before they can be manufactured and sold, and, when sold, the price is not obtainable for a further period—although in this latter case bills drawn on the purchaser would provide funds. Bill transactions cannot, however, be safely carried on without a margin of liquid capital.

If capital is to be kept down, strict attention must be paid to the systematic collection of accounts as they fall due. Book debts are too often allowed to run on, without consideration of the loss of interest incurred and of the capital unnecessarily locked up.

PROGRESS IN THE INTRODUCTION OF THE STEAM TURBINE.

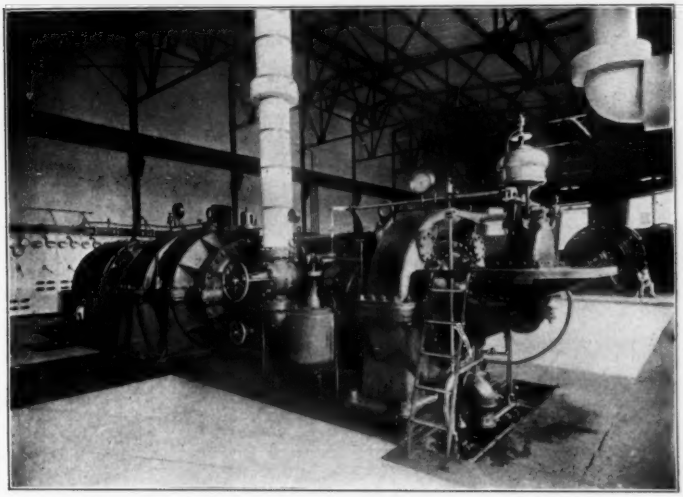
By J. R. Bibbins.

THE steam turbine has to-day reached a state of mechanical excellence and commercial importance nothing short of remarkable, when compared with the development of other types of prime movers, such as the reciprocating steam engine and the gas engine. This rapid development has however been apparent only within a comparatively few years—less than a decade—the period previous to this being one in which ideas regarding proper turbine construction were being crystalized and put into practical shape. The chronology of the steam turbine is interesting, as indicating the unequal and erratic progress which may be made in the various branches of the mechanical arts, as well as the anticipation of modern by ancient inventive genius. The reaction turbine dates back to the time of Hero, and his contemporary, Archimedes, 120 B. C., and was treated in Hero's celebrated work, "Spiritalia Seu Pneumatica." The impulse type is credited to Branca, who brought out his invention in 1629. Less than a century later, in 1705, the reciprocating engine appeared, from which time this branch of steam engineering has received the almost undivided attention of steam engineers. In 1884, Parsons brought out the first turbine of the multiple-expansion type, combining in principle the fundamental features of both impulse and reaction types; this was a double-cylinder, or so called "compound" machine, with steam entering at the center and expanding in opposite directions, thereby balancing the opposite thrusts due to the impinging steam. This turbine ran at 18,000 revolutions, driving the generator for lighting the Tyne steamer Earl Percy.

In 1883 was introduced the original form of DeLaval turbine, a form closely approximating the Hero, or reaction type, and one subsequently employed in centrifugal cream separators. The modern type of DeLaval turbine did not appear until 1889; it is a noticeable fact that the original design has since been departed from in minor

details only. In 1894 the trial runs of the celebrated 2,000-horse-power yacht Turbinia brought to light the unexpected marine phenomenon of "cavitation," followed in 1899 by the record run of the ill-fated Viper, 37.1 knots, or 43 statute miles per hour. The Viper was 210 feet long, 21 feet beam, and her displacement was 350 tons. The aggregate capacity of her turbine equipment was 16,000 horse power, an astonishing figure for a boat of such small dimensions. The Viper was equipped with eight propellers, running at 1,200 revolutions. The Cobra, a sister destroyer of somewhat less displacement, was equipped with an 11,500-horse-power turbine outfit, and attained a speed of 35.6 knots. Both ships were, however, of too frail construction and were lost after a short period of service. In spite of these disasters, which were in no manner due to faulty turbine construction, a third-class cruiser and a number of new destroyers are being equipped with turbines, notable among these being the Velox, Eden, and the Amethyst, the first of which has already made 33.64 knots during an unofficial trial trip in September, 1902. Two Clyde passenger steamers, the King Edward and Queen Alexandra, have recently been put into service and are propelled by Parsons turbine equipment aggregating 3,500 horse power per vessel. These boats have already made record runs of 20.48 and 21.63 knots respectively.

During the period between the introduction of the Parsons marine turbine and the beginning of the present century, this type underwent extensive improvement with the result that it was finally conceded to be the most practical form of the steam turbine, and one most susceptible to future development. Manufacturing rights for special application to power work in America were ultimately acquired by the Westinghouse Machine Co. This company has since completely re-designed the original machine, discarding many features and introducing others which would improve the already remarkable economy. In 1899 the first American turbine installation was put into service at the works of the Westinghouse Air Brake Co., at Wilmerding, Pa., which in connection with a polyphase power-distribution system entirely replaced the original steam-power system of the works. This change in power distribution resulted in a net saving of approximately 36 per cent. in fuel alone, part of which was of course traceable to the more efficient polyphase system. The most recent American turbine installation is that at Hartford, Conn., which has lately excited so much interest on account of the size of the unit and the results secured; the capacity of this turbine is approximately 1,500 kilowatts, or 2,000 horse power, and it is the largest in use in America at the

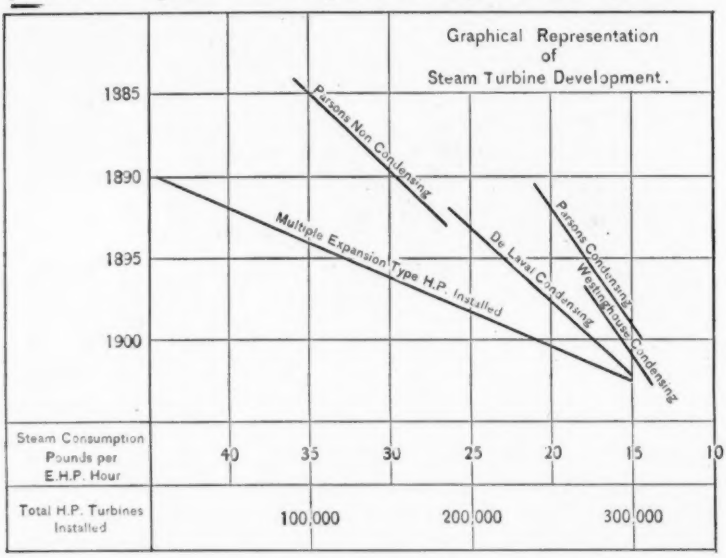


1,500 KILOWATT TURBO-GENERATOR, HARTFORD ELECTRIC LIGHT CO.

present time. A number of turbines of from 1,000 to 5,000 kilowatts capacity are, however, under construction by the Westinghouse Machine Co., both for export and domestic use. It is somewhat significant that the largest of these machines comprising two equipments, aggregating 30,000 kilowatts, will go to England, which has been the seat of development of this type of steam turbine from its inception.

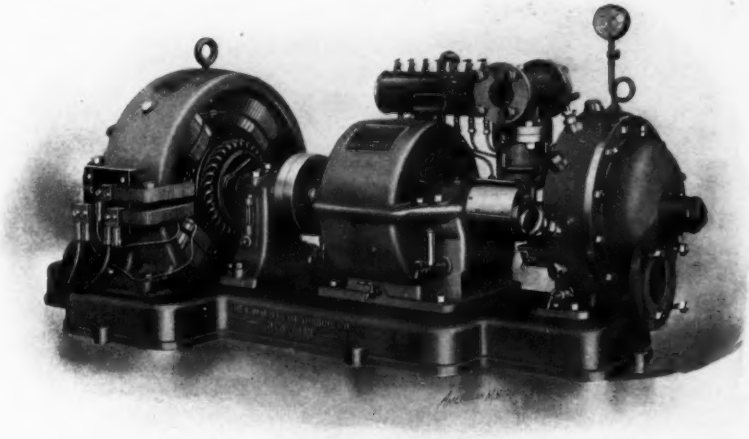
Much progress has also been made in Europe with the steam turbine as applied to power as well as marine work. Turbines of 1,000-kilowatts capacity have already been built and put into operation by the parent company, and still larger ones, up to 3,750-kilowatts capacity, are under construction by Brown, Boveri et Cie., Baden, Switzerland. In a recent paper presented before the British Association, the Hon. Chas. A. Parsons states that in 1890, six years after the introduction of the multiple-expansion turbine, 360 equipments had been put into service, these equipments varying from 4 to 120 horse power in capacity, and aggregating 5,000 horse power. Up to the present time, 800 turbines have been sold, aggregating 200,000 horse power, the largest of these machines having a rated capacity of 3,000 horse power. The Swiss firm has sold since 1900 twenty equipments, the largest of 5,000 horse power. Summarizing: the aggregate sales of all builders of the multiple-expansion turbine, up to the present time, for purposes of electrical generation alone,

approximate 300,000 horse power. In addition, the marine equipments noted elsewhere aggregate 82,900 horse power, thus making a grand total of 382,900 horse power, an increase of 640 per cent. per year of development within a period of 12 years since 1890.



The tendency of modern steam-turbine development has been along three important lines—first, mechanical simplicity, second, steam economy, and third, speed reduction. Of the several types of turbine that have been proposed within recent years, only two have survived the test of application, the DeLaval, or impulse type, and the Westinghouse-Parsons, or multiple-expansion type. Others are employed in special instances on account of their compactness, and the excessive speed that is obtainable. The most important of these are the Dow, which is used for spinning the propeller of the Howell torpedo, and the original DeLaval, or reaction type, employed in dairy processes for operating centrifugal cream separators. The latter two types, however, are not important from the standpoint of power generation on a large scale, such as is now accomplished by the one type which has, by successful development, nearly monopolized this field, the multiple-expansion or parallel-flow type, represented in Europe by the Parsons, and in the United States by a modified and improved turbine—the Westinghouse.

In mechanical construction, the impulse turbine is perhaps the simplest, and employs the principle of the "hurdy gurdy" impulse wheel so common in hydraulic installations of high head. The construction of this turbine, although exact, does not involve such refinements as are characteristic of the multiple-expansion type. From a mechanical standpoint, the greatest functional shortcoming of the impulse turbine is the tremendous velocity of the bucket wheel and the necessary employment of gearing to transform the power derived from the impinging steam to a secondary or low-speed shaft. The design of the bucket wheel provides as far as possible against accidents from centrifugal rupture, but danger is always present from crystallization, or from hidden flaws in the material of the rim or of the flexible shaft. This point is more impressive when the actual rim speed is considered —500 to 900 miles per hour—a speed that is almost incomprehensible when compared to existing standards.

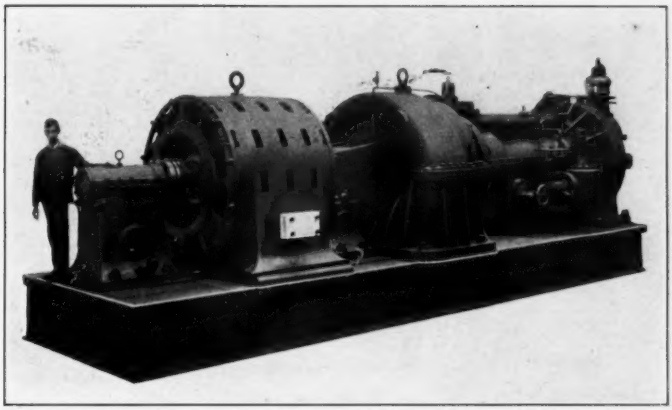


DE LAVAL 30-HORSE-POWER (20-KILOWATT) TURBINE DYNAMO.

This turbine is at present being manufactured in Europe and at Trenton, N. J., in sizes up to 300 horse power, and the latest designs with which the public are familiar follow closely the earlier designs in the arrangement of discs, steam jets, flexible shaft, helical gear, and throttle governor. It is a noteworthy fact that in point of size the gears and gear casing of this turbine occupy more space than the turbine itself. If these gears could be dispensed with, the DeLaval tur-

DE LAVAL TURBINE WHEEL AND NOZZLES.

bine would probably hold the record in point of relative size per unit of output. In the larger turbines, a double set of gears are employed, each driving a separate generator mounted upon an extension to the bed plate. The gears are designed and machined with great accuracy, this being necessary on account of their high speed, which ranges in the several sizes from 7,000 to 40,000 revolutions per minute. The nozzles are interchangeable and designed in such a manner that complete adiabatic expansion of steam takes place therein; the capacity of the machine may be varied between wide limits by the opening or closing of the several separate nozzles with which each machine is equipped. The bucket wheel is also machined with all possible care, its section being such that rupture from centrifugal force will be confined to the rim, into which are fitted the dove-tailed buckets, thus minimizing the extent of damage should rupture occur. The economy of the DeLaval turbine may be maintained at a high point under wide ranges of load by manual control of the nozzles, each of which, operating independently, secures the most efficient expansion of the steam. As the load increases, more nozzles may be put into operation, until the limit of capacity is reached, each step maintaining a high steam economy. This arrangement, however, debars the DeLaval turbine from service involving fluctuating loads. If these nozzles could be placed under the control of a suitable governor, this would largely increase the adaptability of this turbine to general service. In its present form, it is evidently restricted to a somewhat limited field of application. A large improvement in the efficiency of the impulse type may be looked for in the replacement of the throttling method of governing by some other more efficient method by



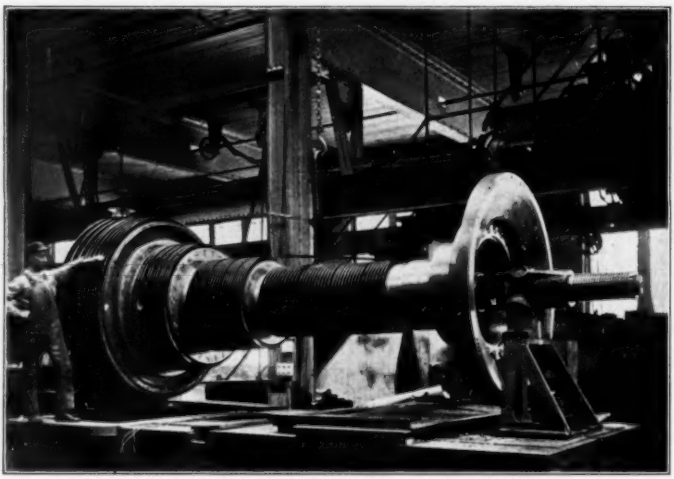
SHOP ASSEMBLY OF 1,500-KILOWATT WESTINGHOUSE TURBO-GENERATOR.

which the full boiler pressure may be utilized. In the present machines, the employment of the throttling governor results in a loss of from five to fifteen pounds of available steam pressure at loads corresponding to maximum economy with the number of nozzles in use. It is thus apparent that the endeavor to reach high thermal efficiency through high initial steam temperature is in a measure defeated by the use of this throttle governor.

Although handicapped by the necessity of speed reducing gear, and the absence of suitable automatic governing, the virtues of the impulse turbine are unmistakable, and it is enjoying extensive application to power work in small units from 1½ to 300 horse power.

The construction of the multiple-expansion turbine has also within the last few years been brought to a state of great simplicity, and difficulties which at first seemed well-nigh insurmountable have been overcome by alterations in the design, construction, and assembling of the component parts. This result has been attained mainly through the elimination of minor defects arising with the increase in physical dimensions, rather than through bold and radical changes in the turbine as a prime mover. The construction employed in the later machines necessitates machine work of the greatest accuracy and refinement, and the employment of the highest grade of materials obtainable, but the resultant turbine is a machine which after initial adjustment is nearly, if not entirely, invulnerable to those troubles which are unavoidable in the best reciprocating-engine practice.

An important feature of the multiple-expansion turbine which



ROTATING MEMBER OF 1,500-KILOWATT TURBO-GENERATOR.

contributes most of all to its constructive simplicity, is the fact that all of its main working parts are built and assembled upon a common center line. Recent Westinghouse construction differs materially from that of other types in the subdivision of the turbine into two parts. This change, however, is adopted in the larger sizes only, and affords opportunity for inserting a re-heater between the two parts, as well as for a considerable reduction of dimensions, which become unwieldy when the single-cylinder design is applied to the larger machines. The parting of the casing at the shaft line proves to be a valuable feature, as it permits access to the working parts by the raising of the cover, which exposes to view the entire spindle.

The problem of accurate balancing of rotating parts has been solved in each type with entire success. The flexible shaft employed by De Laval is familiar. In the Westinghouse works use is made of a specially designed balance which detects with remarkable nicety the slightest unbalancing, due not only to non-coincidence of geometric and gravity axes, but also to irregularities in the various parts of the revolving member which may not be corrected in the lathe, and which introduce, at high speeds, force moments tending to produce objectionable vibration. This balance is so sensitive that it can readily detect unbalancing amounting to only 0.002 per cent. of the weight of the part under test. The shaft is rigid throughout its length, and all vibration during running is completely absorbed by special oil-cush-

ioned journals, consisting of loosely fitting concentric tubes, each being isolated or "floated" by a capillary oil film.

A distinctive characteristic of the multiple-expansion turbine is the method of governing employed. Instead of a steady blast of steam, throttled in proportion to the load, steam is admitted in short puffs, interrupted at regular intervals, and controlled by a sensitive governor of the fly-ball type. The duration of these puffs of steam is in direct proportion to the load on the turbine, each puff being admitted at boiler pressure and allowed to expand through the successive rows of turbine blades. The effect of this procedure upon the thermal efficiency is evident from the fact that thermal efficiency depends largely upon terminal temperature, as expressed in the equation $E = (T_1 - T_2) / T_1$, where E is the efficiency in per cent, T_1 the initial, and T_2 the terminal pressure, referred to the absolute thermometric scale.

From a commercial point of view, the steam turbine is important on account of its compactness as compared with reciprocating engines. The floor space occupied by a Westinghouse turbine of moderate size is roughly two-thirds that of a vertical, and two-fifths that of a horizontal Corliss engine of equal capacity. For a power-house equipment of 1,000 horse power, the total approximate engine-room cost, including real estate and buildings, is, for a turbine outfit, but 62 per cent. and 32 per cent. respectively of that of a corresponding equipment of vertical and horizontal Corliss engines. These figures are conservative, and a visual comparison of the two types of prime-movers only serves to accentuate them. The compactness of the turbine is largely due to the concentration of working parts into a single moving element, the absence of means for affecting a transformation of motion, necessary in a steam engine of the reciprocating type, and the employment of the simplest possible form of motion—rotation—for converting the energy of the working fluid into useful torque. The resultant motion fortunately happens to be suitable for direct power application in general, and especially so for the direct driving of alternating-current generators, a result accomplished with reciprocating engines only through the employment of large fly-wheel capacity, and heroic design of both engine and generators. Parallel working with the turbine becomes the simplest of operations, due to the entire absence of cyclical speed variations, which prove so troublesome and expensive in the case of the reciprocating engine. The speeds at which the later turbines operate further contribute to economy of gererator construction, by reducing the number of poles required for a given

frequency. A few comparative figures illustrate this point:—The 5,000-kilowatt generators recently installed by the Manhattan Railway Co., N. Y., have 40 poles, an over-all diameter of 42 feet; and a speed of 75 revolutions, giving a frequency of 25 cycles per second; the 1,500-kilowatt turbo-generator unit at Hartford runs at a speed of 1,200 revolutions and a frequency of 60 cycles, necessitating 6 poles. Preserving the present construction, the Manhattan generator for 60 cycles would have a diameter of 100 feet, or twenty times that of the turbo-generator. The weight of the Hartford unit per rated horse power is 116 pounds, as compared with 400 pounds for the N. Y. Edison 6,500-horse-power units, and 500 pounds for the 4,500-horse-power units of the Boston Elevated Railway.

Concerning the point of speed reduction, much advancement has been made with the multiple-flow type through the simple expedient of increasing the ratio of expansion. The first Parsons turbine ran at 18,000 revolutions. In the modern machines of this type, speeds have been reduced to nearly 4 per cent. of this figure, thereby making possible the direct driving of generators and other apparatus without the interposition of speed-reducing gear. With the impulse type, practically no advancement has been made in speed reduction. The theoretical bucket speed, corresponding to maximum efficiency, is one half that of the steam issuing from the jet. This may, with a condenser, reach 4,000 feet per second, or 45 miles per minute, 50 per cent of which, 2,000 feet, is far beyond safe rim speed, thus introducing a further source of loss of economy which, though not prohibitive, is irremediable when only one expansion is attempted. The speed reduction of the multiple-expansion type is obtained by assembling turbine wheels in series ranging from 20 to 100 in number, according to conditions of vacuum and steam pressure, each wheel operating independently and contributing its proportion of the total torque to the shaft. The steam expansion in this type, in contradistinction to that of the jet type, is continuous from point of entry to point of exit. Each successive row of steam passages is so proportioned as to accommodate the increased volume of steam accompanying each succsive step in the stage expansion. It is a point worthy of note that the extraordinary expansion secured in the multiple-expansion turbine is not accompanied by successive increase in either the size of the machine as a whole or in mechanical friction. With saturated steam, the usual extremes in temperature on the turbine casing range from 365° F. at the admission end, to about 126° F. at the exhaust end, this being accomplished, in the smaller sizes, within a distance of three or four

feet. These temperatures correspond to a ratio of expansion of 1/64, which is ordinarily prohibitive in the reciprocating engine, and would involve an engine construction of such unwieldy nature that the losses from friction and initial condensation would many times exceed the benefit to be derived from stage expansion. As these losses are practically obviated in the turbine, it is evident that stage expansion may be profitably carried to the limit of condenser capacity, practically one pound absolute.

In point of steam economy, the multiple-expansion turbine at present excels, due to the greater range in terminal temperatures employed. The original Parsons turbine gave a steam economy of 35 pounds per electrical horse power, at 92 pounds pressure, equivalent to about 27½ pounds for indicated horse power at engine rating. A later turbine of Parsons, built in 1892, reduced this consumption to 27.6 pounds, and 20 pounds per electrical horse power were secured at 115 pounds steam pressure, with 60° F. superheat and 28 inches vacuum. In 1900, a 1,000-kilowatt turbine, built by Parsons for the Elberfeld corporation, showed an economy of 14.5 pounds per electrical horse power, with 130 pounds steam pressure, 27° superheat, and a high vacuum, which has since been slightly exceeded by large machines. The first American turbines tested were the 400-kilowatt units installed in 1899 at the Westinghouse Air Brake Works. They showed an economy of 16.4 pounds per electrical horse-power hour, with saturated steam at 125 pounds pressure and 26.5 inches vacuum. The second, and largest unit, installed at the Hartford Electric Light Co., shows a steam consumption at full load of 14.25 pounds per electrical horse power with steam at 150 pounds and 42° superheat. This consumption is equivalent to approximately 12 pounds per indicated horse power (85 per cent. total efficiency) at engine rating.

The economy of the impulse type of turbine has likewise undergone great improvement within recent years. The earliest machines of this class appeared in 1889. In 1892 a 50-horse-power machine running condensing, showed an economy of 26.5 pounds per electrical horse power. In 1896, a 10-horse-power turbine was tested at Sibley College, yielding an economy of 46.9 pounds per horse-power hour. A similar machine, tested later by Professor Goss, with four nozzles in action gave a maximum economy of 47.9 pounds per brake horse power, at 126 pounds steam pressure and 26 inches vacuum. A 150-horse-power turbine tested by Professor Cedarblom in 1897, consumed 19.6 pounds per electrical horse power, with 114 pounds steam pressure and 26.4 inches vacuum. The latest results upon the De-

Laval turbine are furnished by the American builders upon a 300-horse-power turbo-generator outfit recently tested at Trenton, N. J. This turbine was fitted with eight nozzles and used superheated steam at 200-pounds pressure; the economy at full load, with 64° F. superheat, with a vacuum of 27 inches, and all nozzles in action, was 15.4 pounds per electrical horse power. With saturated steam, the consumption at full load increased to 16.8 pounds per electrical horse power, and with only three nozzles in action this consumption rose to 20.2 pounds per electrical horse power. Although the high economy here obtained is in a measure due to the high steam pressure employed, these results are highly encouraging as indicating a close approximation to correct design.

An interesting investigation was carried out in 1897 by Prof. Jacobus, upon a 15-horse-power DeLaval turbine for the purpose of definitely ascertaining the effect of entrained moisture upon steam economy. The results indicated that the net consumption was the same for either dry or wet steam, and that to obtain the actual steam economy it was necessary only to correct observations for entrained moisture. This would appear to invalidate the theory of excessive fluid friction in the steam turbine when water of condensation is present. It is obvious that maximum thermal efficiencies are obtained only when adiabatic expansion is carried to the extreme. Although this may be readily secured in the turbine, the condensation at the end of the expansion might be considerable, entailing corresponding mechanical and thermal losses. If, however, the steam is superheated before admission, the point of condensation is deferred and the larger part of the working cycle is free from entrained moisture. Superheating is now used extensively in all turbine work, resulting in decided economies. It is likewise important to secure the highest possible vacuum, in turbine condensing systems, for the reason that the last expansion stages in the steam cycle are so easily provided for. At the present time, it is not unusual to exhaust at a pressure and temperature but little above that corresponding to the working vacuum. The following figures, derived from the Elberfeld tests by Messrs. Lindley, Schroeter, and Weber, indicate the economy of high vacuum and superheat. For each additional inch of vacuum an increase of 4 per cent. in economy was realized, and a superheat of 100° F., or 55° C., resulted in a similar gain of 12 per cent. These facts have evidently received serious consideration in modern turbine installations, many of which are operating with vacua of 27, 28, and even 29 inches, together with superheat temperatures ranging as high as 200° F.

A closing reference may be made to the Rateau turbine, lately introduced in France, and to the Curtis, a turbine now undergoing development in America but not yet placed upon the market. Both machines are designed upon the principle of the impulse type, compounded to a sufficient number of steps for the necessary speed reduction. The Rateau machines are manufactured in Paris and Switzerland, it is stated in sizes up to 1,200 horse power, but no official information appears available further than general details of construction. The Rateau machine is built in two stages, somewhat similar to the multiple-expansion type. The rotating part consists of a single shaft supported by two outer bearings and one inner, upon which are mounted twenty-five impulse wheels, fifteen in the first stage and ten in the second. These wheels have dished sheet-steel centers, and radial buckets riveted to a peripheral flange. Between each pair of rotating discs is mounted a stationary disc or diaphragm, containing around its periphery four groups of guide blades. These diaphragms fit accurately the interior of the casing, but surround the shaft with a loose fit. Steam enters the turbine through four segmental groups of guides corresponding to four jets in the impulse type. The subsequent increase in volume is provided for by gradual increase in area of the four peripheral jets containing the guide blades. The turbine is especially designed for marine service, as no provision has been made for axial thrust other than that furnished by reactionary propeller thrust.

The Curtis turbine resembles in some respects the Rateau in the employment of a series of impulse wheels for obtaining speeds suitable for general power work. The machine possesses many valuable features but is practically unknown at the present time. Its probable appearance in the near future will, however, serve to stimulate further the interest of steam users, already aroused to the possibilities of the turbine by the performance of those now in use.

From the foregoing, it is apparent that within a period of less than two decades the steam turbine has reached a state of mechanical excellence and economy equal to, if not greater than, the best types of stage-expansion engines in existence. The steam engine has, through nearly two centuries of continued improvement, reached the zenith of its career of usefulness, and is in danger of replacement by either one or both of its two thermo-dynamic superiors, the steam turbine and the gas engine. The present field of usefulness for the turbine is broad, and the advancement which has already been made towards its ultimate perfection presages the most excellent results for the future.

EDITORIAL COMMENT

THE advance of civilization has been marked—almost measured—by the progressive withdrawal of Government direction of private and business affairs. This is not the philosophy of Socialism, but it is the reading of fact. Whether one regards greater individual enlightenment as the natural outgrowth of greater personal and public liberty, or considers the greater freedom a condition permitted by wider-spread and higher average intelligence, depends upon his school of thought; but whatever his interpretation of the evidence, he will see that, viewed in the large, it shows the distinguishing feature of political advance to be the continual shrinking of the functions of government within an ever-contracting field, and the complementary enlargement of the province within which the social or industrial unit is freed from physical restraint.

It is deplorable, therefore, when a step backward is needed—when police powers must be reasserted and used upon some individual who has not the sense or the morals to be allowed freedom in the direction of his own affairs. Such a spectacle, unfortunately, has just been offered in the necessary intervention of the municipal and State powers to compel some sort of decency in the conduct of the local railways of New York City. It is the more humiliating because in this very field we have lately been offering to set others' houses in order—because in all that goes to the mechanical handling of huge railway problems we have made reasonable claim to be able to teach the world. The traffic conditions are admittedly difficult in New York, but no one could maintain for a moment that the transportation companies—especially the Manhattan Railway and the Brooklyn Rapid Transit—have done half what ordinary intelligence would find possible in solving the problems presented. How poor was the service is well shown by the fact that a public commission, after a very brief examination, could formulate relief measures which, whatever may be thought of their entire sufficiency, are admittedly wholly practical.

For the surface lines there is much excuse in the ill-regulated, or rather chaotically unregulated, street traffic; but it would be an insult to the intelligence of the management of the elevated railways to assume that the brutalities of the present service could not be greatly relieved if the rights of the public, rather than the collection of the largest possible number of nickels at the smallest possible expense, were made the first consideration. As it was, however, the policy of "the public be damned" has been allowed to direct until a too-long suffering community has undertaken to deal with this archaic institution as its semi-civilized state demands, and curtail the freedom to direct its affairs which it has proved its unfitness to exercise.

* * *

THE coal famine is bringing home, as perhaps nothing else could, another point in which the public welfare has been of no consideration to those who were seeking private advantage. The settlement of labor disputes by strike, at any cost to the helpless third party—

the public—has been of scarcely more than academic interest to that third party because the invasion of its interests has generally been too remote or too local to be generally appreciated. But to touch the coal pile is to touch the heart of modern life, and the whole country is keenly interested in the public inquiry into the conditions which made last summer's deadlock, and this winter's consequent suffering, a twentieth century possibility. So far, the showing has been little creditable to either side. But sunlight goes a long way toward curing disease, and the mere bald uncovering of the evils which have been hidden in this fundamental industry may do much toward bettering labor relations throughout the country.

* * *

ONE of the most interesting things which has appeared of late in the domain of electrochemistry is the fact that it has been found advisable to form a commercial organization for the express purpose of conducting a continuous campaign of scientific research.

Thus there has been organized at Niagara Falls a company whose object is not to manufacture anything in particular, but to conduct experimental researches upon a large scale with a view of developing methods and processes in electrochemistry for disposal to operating companies or other purchasers. When it is understood that the control of this organization is in the hands of such well known scientists as Professor F. B. Crocker, Mr. C. A. Doremus, Mr. S. S. Wheeler, and others, it will be understood that it is no speculative matter, but a serious and well equipped attack upon such problems as offer any reasonable prospect of successful solution.

Already the work of members of the company has developed such results as the method of producing artificial corundum by the fusion of bauxite, and also the process of fixation of atmospheric nitrogen and the production of nitric acid and artificial nitrates, both of which processes are in commercial operation by undertakers to whom they have been disposed. Other investigations are constantly being carried out, and with the command of electrical energy available at Niagara Falls, there is every reason to believe that many valuable developments in the field of synthetic electrochemistry will result.

Apart from the special interest which must be felt in such a combination of science and business, this undertaking attracts attention as showing the difference between modern methods and those of the old-time inventor. Invention, the finding out of things, formerly was supposed to belong to certain individuals possessed of the divine spark, much in the same manner as a musician is supposed to develop and record the inspirations which he receives. Now, however, systematic attacks are made upon natural forces, and all the resources of the physical, chemical, and mechanical laboratories are brought to bear upon their secrets. In this respect the engineer is simply doing what the chemist has done long before. The period of empirical trials and experimentation of the alchemists has been replaced by the orderly and systematic investigation of the analytical laboratory, and it is altogether in the order of progress that the mechanical and electrical laboratory should join in this rational and effective method of development. The interesting thing about this present undertaking lies in the fact that it is a cold business proposition, and thus adds another to the series of instances of the appreciation of the commercial value of theoretical scientific research.

* * *

WE are reminded again of the shortcomings of the daily press in reporting technical matters by an elaborately intricate bull, gravely put forth recently

by a newspaper which has always been noted for self-satisfaction that it is not as other papers are, unreliable, untrue, but rather an absolute guarantor of accuracy. The freak item in this case was a special dispatch giving a minute history of an accident by which a student had been shocked to death as he sat in his room, his feet resting on the radiator and his hand clasping an electric lamp. An "electrical expert" who was called in found "a current of 572 volts," which showed that "just twice that number, or 1144 volts, were loose somewhere about the place." The mystic number "suggested the explanation." There was a high-tension current of 1040 volts entering the building, which was stepped down to 104 volts for the lighting service. By the aid of a "fallen guy wire" and passage through "200 feet of frozen ground," the two currents had both got on to the same wire, and there you are—1040 + 104 = 1144. The "eleven-forty-four" are accounted for, but what has happened to the "four" which usually forms the first member of the famous "gig"?

To err is human, and even Jove nods. But it certainly seems unnecessary to go out of the way to invent and elaborately embroider stories so grotesque as this.

* * *

THE plan of the United States Steel Corporation to include its employees among its stockholders, according to the scheme widely announced in the newspapers, has successfully passed its first stage by the general acceptance of the method by the men. The total amount of stock allotted by the finance committee has been over-subscribed, there has been no serious opposition by labor organizations, and the whole affair is launched. With such an excellent start there is every reason to believe that the ultimate purpose of the Corporation in undertaking the scheme will be to a great extent accomplished. This purpose, as contained in the announcement circular, is, in brief: to associate the employees in the work of more closely organizing and systematizing the business of the Corporation as a harmonious whole; to interest the men in the reduction of general expense; to offer to the men an inducement to remain permanently in the service of the Corporation; and to avoid the defects in those profit-sharing plans which depend upon the working of local portions of a plant for their operation.

The extent to which these objects are accomplished will be watched with interested attention. At the recent meeting of the American Society of Mechanical Engineers one of the members stated that a certain preventive of labor troubles was to give the workmen an interest in the business. Those who do not want labor troubles prevented, professional agitators and the like, will see in the plan a deep-laid scheme to undermine their efforts, but so far any under-current of opposition has been either stemmed or suppressed. Some will doubtless class the scheme with so-called "gift" methods of remunerating labor, but others will see in it but a method of determining what the real value of labor is, and as such commend it as a stride in the right direction.

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BY an error of transcription, the Gould storage battery and booster shown on pages 573 and 574 of our January number were described as installed in the "Commercial Cable Building." It should have read "Commercial Building." The Commercial Cable Building has a Chloride Accumulator installation put in by the Electric Storage Battery Co.

REVIEW OF
THE ENGINEERING PRESS.
"THE WORLD IS ITS FIELD"

LIMITATIONS IN HEAVY ELECTRICAL ENGINEERING.

SOURCES OF POWER FOR THE GENERATION OF ELECTRICITY AND PRACTICAL METHODS OF APPLICATION.

James Swinburne—Institution of Electrical Engineers.

MR. SWINBURNE is always entertaining, even if he is not always strictly accurate, and his presidential address before the Institution of Electrical Engineers shows him at his best in both respects.

Readers of *Punch* in days gone by may remember a clever cartoon in which Mr. Gladstone and Lord Beaconsfield are represented as standing at a book stall, each with a book in his hand; Gladstone dipping into Lothair with a contemptuous look on his face, and Beaconsfield looking at Juventus Mundi. Says Gladstone: "Ha, flippant!" while Beaconsfield, with a look of disgust, replies: "Hum, prosy!" So it is with presidential addresses. Too often one cannot but echo the refrain: "Hum, prosy!" and so we must not yield to the temptation which at first besets one in reading Mr. Swinburne to exclaim: "Ha, flippant!" For there is much good stuff in Mr. Swinburne's address even if it departs somewhat from the portentous solemnity which is usually considered necessary upon such momentous occasions, and although dreams of the future must be expected to be more or less fantastic, like all dreams, yet this one is at least founded upon fact.

The main fact with which Mr. Swinburne concerns himself, after some pleasantries upon the relation of applied science to practice, and the especial mission of the electrical engineer to set all his older engineering brethren right, is the nature and extent of the limitations of heavy electrical engineering. At least that is what the title indicates to be the subject, although the matter itself relates far more to the general subject of power generation than to its subsequent transmission and application by means of electricity. Like very many electrical engineers, Mr. Swinburne, having extended the scope of his work to the broad domain of mechanical engineering, calmly assumes that it is all henceforth electrical, and proceeds to treat it as such.

Starting with the development of power from falling water, he dismisses the energy of the tides as unprofitable, mainly because of the great capital expenditure necessary to obtain a continuous power of any magnitude, and proceeds to examine the utilisation of waterfalls in general. There is no doubt that there has been much foolish talk about the advantages of water power, especially as regards its low cost, but it is now fairly well understood that the interest upon the first cost, together with establishment and depreciation charges, form a very material element in the cost of hydraulic power, but that in spite of these facts new water powers are being developed continually in those parts of the world so fortunate as to be possessed of suitable sources. It is indeed true that water power is not generally where it is wanted for existing industries, but experience in various parts of the world has shown that one of the notable effects of the development of water power has been the creation of new industries, notably in the domain of electro-chemistry, and that these new industries have not the slightest objection to establishing themselves

even in somewhat out-of-the-way localities. The statement that a water power, to be really valuable should be on the sea, will be interesting news to the great companies at Niagara, at Rheinfelden, at Foyers, or at the Sault-Sainte-Marie. The idea that it is only the landlord who is benefitted, hardly agrees with the facts as to the inducements which power companies offer to prospective power users in connection with building sites, but possibly all our ideas upon these subjects are in need of revision. So far as the electrolytic production of alkalies is concerned, their development at water-power sites is a matter of record, and in the United States, at least, it is well known that one of the greatest manufacturing companies concerned with the production of alkalies is quietly occupied in the development of available sources of water power, to hold as a reserve in case the newer process should become of sufficient competitive importance.

The production of electricity directly from carbon is shown by Mr. Swinburne to be in contradiction to the modern theory, since carbon never forms ions, has therefore no solution pressure, and can therefore give no electromotive force.

Concerning the steam engine as a means of developing motive power from heat, Mr. Swinburne shows that any possible improvement in efficiency depends upon the extension of the heat range, and is of the opinion that this is more probably to be extended at the lower end than at the upper. The advantages of superheating are shown to be due mainly to the reduction in cylinder condensation and not to the getting of more energy into the steam, a point which is very well appreciated in steam engineering circles already, but it is precisely in this matter of cylinder condensation that the greatest gains in economy are possible. As for greater range of temperature, that is certainly to be found in the use of the internal combustion engine, and not in the steam engine. The small gain to be expected from any form of binary vapour engine does not appear to warrant the additional complication involved.

Having set the engineering world right with regard to water-power, steam, and gas engines, Mr. Swinburne proceeded to explain that he differed with Clausius, Zeuner, and Macfarlane Gray concerning the nature of entropy, and that he considered 90 per cent. of the text books to be in error on the subject. The orthodox conception of entropy may safely be left in the hands of its friends for defence, and already Professor Perry has joined issue with Mr. Swinburne on the subject, so that point need not be further discussed here. Mr. Swinburne also appears to have just discovered the Diesel motor, and kindly offered to defend it against any prejudices which might appear against it in England because of its extreme novelty, notwithstanding the fact that it has been before the engineering world for more than five years.

Finally coming to electrical matters, Mr. Swinburne discusses dynamos, transformers, cables, batteries, and lighting problems in a most interesting and forcible manner. Dynamos and transformers he considers to have nearly reached their limit of improvement, the efficiency of generators already being so high that any further reduction in losses would make no appreciable difference in the total efficiency of a station.

In the field of accumulators, however, there is undoubted room for improvement. Even with its present defects it is of great value for equalising purposes in central-station work, and further improvements may be expected to produce very great changes in important branches of engineering. At the same time he seems to be convinced that we are limited almost absolutely to lead and sulphuric acid as materials for accumulator construction. The requirements are extensive. We want lightness, large capacity, cheapness, rapid discharge, efficiency, mechanical strength and durability, and many of these requirements are antagonistic. Large capacity means rapid deterioriation, while mechanical strength means weight. It is almost impossible to make intelligent comparisons between published reports of battery performance because essential facts are omitted.

Concerning the nickel-iron battery, with alkaline electrolye, Mr. Swinburne is unable to speak at length, owing to the limited amount of reliable information available.

There is material room for improvement in cable insulation, and notwithstanding the great importance of the subject, there is no branch of electrical industry which is run on

less scientific lines. At the present time the whole art of cable making is a question of trial and error, with the latter element predominating. Even the matter of cable testing is subject to no definite rules, and hence little systematic information is available.

Condensers are dismissed as being hardly worthy of discussion in view of the small demand for their use, but the subject of light is taken up at length. Naturally the whole trend of this portion of the address is toward a higher degree of efficiency in the conversion of energy into illumination. The cold light of the glow worm and the fire-fly appears to be as far away as ever, although there is no thermo-dynamical reason why electrical energy should not be converted directly into radiation of any wave length without loss. Apparently the limits are altogether practical—the thing may be done, but we have not yet hit on the way of doing it. The Cooper-Hewitt mercury vapour lamp is apparently in the line of progress, but the colour of the light is objectionable.

The arc light is also open to improvement, mainly in the direction of the utilisation of the large portion of light now lost in the crater. In addition to this the electrical power in the space directly between the electrodes should also be converted directly into light, and added to the radiation from the incandescent carbons.

Mr. Swinburne discussed also the future possibilities of electric traction, together with the vexed problem of the electrolytic corrosion of buried pipes by stray currents, and thus closed a most interesting and stimulating address.

THE ELECTROLYTIC ALKALI INDUSTRY.

ITS PRESENT POSITION IN VARIOUS COUNTRIES IN CONNECTION WITH THE UTILISATION OF HYDRAULIC POWER.

John B. C. Kershaw—The Electrician.

IN a series of papers reviewing the present position of the electrolytic alkali industry, published in recent issues of the *Electrician*, Mr. John B. C. Kershaw shows the relations of the electrical process to the earler methods, and discusses the relation of market conditions to the development of the industry. Since the greater portion of the electrolytically produced alkalies is the result of the utilisation of hydraulic energy, this review forms also an indication of the extent to which water power enters into the question of competition.

In Great Britain hydraulic power does not appear in the question, but the cost of fuel does, and it is a significant fact that the Castner-Kellner Company has decided to introduce Mond gas for firing at their works at Weston Point, in order to offset the increased cost of solid fuel. The total amount of power used at Middlewich and Weston Point is now 7,000 horse power, corresponding to a production of about 25,000 tons of bleaching powder per year by the electrolytic process.

The industry appears to be making fairly satisfactory progress in Germany, both by the use of steam and hydraulic power. At Bitterfeld a steam plant of 4,400 horse power, is in operation, using brown coal for fuel, and producing by electrolytic processes 7,200 tons of caustic potash and 12,250 tons of bleaching powder per year. A branch of the same company at Rheinfelden is utilising 3,400 hydraulic horse power, producing 5,800 tons of caustic potash and 10,000 tons of bleaching powder, besides a quantity of calcium carbide. In connection with the output of the works at Griesheim the total output of electrolytic alkalies amounts to 25,000 tons of caustic potash and 40,000 tons of bleaching powder per year, this exceeding the home consumption to such an extent that the exports are more than 25,000 tons.

In France electrolytic methods are used in a number of establishments. Thus the Société des Soudières Electrolytiques is using 2,600 hydraulic horse power for the production of sodium and sodium peroxide at Les Clavaux Isère. The St. Gobain Chemical Co., the Societe des Fives-Lille, and the Compagnie Générale d'Electrochemie are operating plants of moderate size, while others are in course of construction. The development of the alkali industry in France is undoubtedly dependent upon the course of market conditions, and for the present, at least the greater portion of

bleaching powder there will continue to be produced by the old Le Blanc process. Of the total of 30,000 tons manufactured in 1900, more than one-third was for export, showing that the development of the industry is dependent upon the development of export trade.

Switzerland has at present only two works in active operation, one being the Société Suisse de l'Industrie Electrochimique Volta at Chevres, near Geneva, with an annual output of 600 tons of caustic soda and 1,440 tons of bleaching powder; and the other the Société des Usines de Produits Chimiques des Monthey en Valais, equipped with 1,500 hydraulic horse power, and producing annually 1,000 tons of caustic soda and 2,500 tons of bleaching powder. In view of the uncertain state of the market at the present time both of these establishments are devoting a portion of their power to the manufacture of pharmaceutical products.

In other parts of Europe electrochemical works are in operation, and Mr. Kershaw notes establishments in Belgium, Russia, Austria, Italy and Spain. These are mainly operated by steam power, and in Belgium and in Russia the works are under the control of the Solvay company.

"Summarising the details given above as regards the power available and in actual use in Europe for the production of alkalies and bleaching powder by electrolytic methods, it appears that about 40,000 H. P. is available, and that only about 28,000 H. P., or rather more than two-thirds of this power, is at present being utilised in the industry. The recent fall in the selling price of bleaching powder will probably, still further reduce this total, for the owners of the electrolytic alkali works are likely to devote an increasing proportion of their power to the production of fine chemicals and by-products, which offer a large profit to the makers.

"The position of the electrolytic alkali industry is, perhaps, on the whole more promising in the outlying countries of Europe, which up to the present time have depended altogether upon the United Kingdom, Germany and France for their supplies of the heavy chemicals—soda and bleaching powder. In Russia, Italy, Spain and Austria some development and expansion of the industry may therefore, be expected, and in time the home demand of these countries will, probably, be entirely supplied by the locally-situated works.

"In the United Kingdom, Germany, France and Switzerland the position is less favourable, for the home demand is already more than covered by the production, and a considerable proportion of the output is exported. With the growth and development of electrolytic processes in other countries this export trade in heavy chemicals is likely to decline in volume and value, and the further expansion of the electrolytic alkali industry in two of the four countries named can only take place by the decay and decline of the older Le Blanc process, which still supplies in the United Kingdom and in France more than three-fourths of the total production of bleaching powder."

Coming to the United States, it appears that the Castner Electrolytic Alkali Company, at Niagara Falls, is the largest producer of alkali and bleach in America. This company is at present using 6,000 hydraulic horse power, and producing 36 tons of caustic soda and 90 tons of bleaching powder per day. The Ackers Process Company, also at Niagara Falls, is producing alkali and bleach by the electrolysis of salt. This method is based upon the electrolysis of fused salt with molten lead as cathode. At the present time more than 3,000 horse power is used, with a production of about 12 tons of caustic soda and 26 tons of bleaching powder per day, and the works are being enlarged. The process is noteworthy for its efficiency, the product and current consumption showing a current efficiency of 92 per cent., and an energy efficiency of 55 per cent.

The American Alkali Company, at the Sault Sainte Marie, uses 1,000 horse power, and has a capacity of about 3,000 tons per year, and there are other smaller establishments. Mr. Kershaw makes some analysis of costs with such data as are at his disposal, and shows that the total cost of 1 ton of 72 per cent. caustic soda, and 2.1 tons of 35 per cent. bleaching powder by the best of the electrolytic processes will be about £14. The present selling value of the above amounts is about £22, and the value when the drop in the value of bleach will become effective is £17.5s. Even under the present and immediate future conditions, therefore, business prospects are not unfavorable.

THE REMOVAL OF OCEAN BARS.

UTILIZATION OF THE REACTIVE EFFECT OF CURRENTS FOR THE DEEPENING AND MAINTENANCE OF CHANNELS.

Prof. L. M. Haupt—American Association for the Advancement of Science.

THE question of the improvement of harbors by the deepening of channels is a matter of pressing importance. Already the great cargo steamers have reached a draught closely approaching the limit of depth of the most important ports of the world, and in some instances the tides have to be closely watched before vessels of more than 30 feet draught can venture over the bars of such harbors as New York and other great ports. When it is realized that still larger vessels are under consideration and that the great economy of large cargo carriers indicates the possibility of a demand for vessels of 1,000 feet in length and at least 40 feet draught, it will be seen that deeper channels must be obtained in response to the demands of commerce.

Under these circumstances the paper presented before the meeting of the American Association for the Advancement of Science, at Washington, by Professor Lewis M. Haupt, treating of the utilization of reaction in the removal of ocean bars, is of present interest.

At the present time the principal methods for deepening the channels through ocean bars are by dredging, by the use of dynamite, and by the construction of twin jetties. Usually the method relied upon is a combination of jetties and dredging, the latter being found necessary to assist in maintaining the channel produced by the former.

Where there is a sufficient discharge, as at the mouth of a great river like the Mississippi, two parallel jetties give good results, although even there some dredging has been found necessary. In like manner parallel jetties have been most successfully used at the mouth of the Panuca river, Tampico, Mexico, but this method involves the existence of a river discharge from above, and of a littoral current of sufficient strength to remove the sediment carried out beyond the jetties, otherwise a new bar is apt to form.

In late years, however, there has been appeared a disposition to study and imitate the methods of Nature in the control of hydraulic channels, especially in river regulation, and this method has been developed so far as it is applicable to harbor improvement by Professor Haupt in the design of the so-called reaction breakwater.

A study of natural deep channels shows that they are not formed between parallel banks, but almost invariably occur on the concave side of curved banks. Furthermore, the greatest depths are not necessarily in the path of the greatest current velocity, but appear where the scour of eddies bores into the sand or mud. Unless aided by artificial guidance, however, the depths produced by the action of the movements of the water itself, are rarely in the locations required by commerce, and hence some structure arranged so as to augment and guide the natural action of the existing forces becomes necessary.

The abnormal depths sometimes met in portions of channels are caused, in Professor Haupt's opinion, by eddies operating in a vertical plane, these eddies being caused by obstacles placed in the path of the current in such a manner as to retard the flow by the interference due to converging forces. The result is the production of a head producing downward scour, until compensation is secured by enlarged aperture. Such an action is necessarily supplemented by an upward resultant, accompanied by deposit, a bar being the sequence of a pocket, unless other forces come into action.

By producing eddies in a horizontal plane the effects of scour can be produced in any desired location by the construction of a single curved breakwater of proper shape and position. This method which has been advocated by Professor Haupt for a number of years, has been tried in several cases, and found effective in training the natural forces in the water to do the work without assistance from dredging.

In this method it is seen that physical agencies become of fundamental importance, and hence they must be carefully studied in each instance and the work adap-

ted to the location under consideration. Bars formed from littoral drift must be clearly distinguished from those due to the detritus carried down by streams. For tidal inlets it is also important to ascertain the prevailing direction of the littoral movements. These have frequently, but erroneously been supposed to follow the prevailing winds, whereas they are more frequently found to be the resultant of the configuration of the adjacent coast line and of the angular wave movements, especially during the flood tide, when the waves are most heavily charged with silt.

For tidal inlets it is necessary to provide free admission of the flood tide, this being the only available source of ebb energy, together with protection of the bar channel from the prevailing direction of littoral drift. By then conserving the energy of the ebb tide, as it passes seaward, its action may be concentrated upon the bar crest. This result may be accomplished by the construction of a single curved breakwater, placed in the way of the ebb current in such a position as to maintain a continuous reaction along its concave face.

In order to protect the proposed channel from littoral drift, the jetty should not be submerged, but should rise above the highest tide. It should also be placed between the channel and the source of the prevailing drift, just as a snow or sand fence must be placed to windward to protect a line of railway. It should be curved concave to the effluent currents, in order to develope a continuous reaction, and should be constructed inwards from the outer slope of the bar, to avoid the advance of the crest and to utilize the force of gravity in cutting downwards, instead of upwards.

Professor Haupt discusses at some length the conditions existing in New York harbor, as well as at other points, and refers to the success which has attended the action of a breakwater constructed according to his plans at Aransas Pass, Texas. The extent to which natural forces may thus be directed to produce and maintain deep channels appears to be limited only by the nature and force of the currents, and in nearly every case it appears that a single curved jetty, properly shaped and placed will do the work better than a pair of parallel ones, especially in the case of pure tidal action.

MODERN REFUSE DESTRUCTORS.

COMPLETE COMBUSTION AT HIGH TEMPERATURES ESSENTIAL TO SUCCESSFUL OPERATION—STEAM GENERATION A SECONDARY CONSIDERATION.

W. Francis Goodrich.

EVER since the stir which was made by the successful operation of an electrical generating plant from the waste heat of refuse destructors at Shoreditch, the question of getting steam power has been a prominent element in destructor design. This is only natural, since the disposal of refuse has generally been an important element of municipal expense, and any prospect of meeting at least a portion of that expense was welcomed. At the same time it is possible to carry the utilisation theory too far, and to lose sight of the main question at issue, the complete and satisfactory conversion of refuse into inoffensive inorganic matter. In a paper recently presented before the Manchester Local Section of the Institution of Electrical Engineers, Mr. W. Francis Goodrich, states the case for the modern destructor in a very intelligent and instructive manner, and some abstract of his views is here given.

In the first place it must always be borne in mind that high temperatures are absolutely necessary for the satisfactory combustion of refuse. This is especially important when the generation of steam forms a portion of the operation. The combustion chamber should be maintained at a temperature of at least 2,000°F., and higher if possible, and never, even for a brief period be permitted to fall below 1,600°F. Continuity of high temperature is the essential, not only for complete combustion, but also for steady steaming, and this feature should be kept constantly before the designer.

It will at once be realised that this condition is not compatible with close proximity of the boiler to the burning refuse, since the temperature of the water surfaces

will always be below 400°F. Even when the boiler is placed well beyond the combustion chamber, and the latter is made of ample size, care must be taken that the furnaces are not cooled. Thus, when cells are erected in pairs, with the boiler between them, so that one out of the two shall be in full work while the other is being charged and clinkered, it often occurs that the heat which should be assisting the cell which is being clinkered is abstracted by the boiler, and imperfect combustion is the result. Under such an arrangement there may be a cell in full work on one side of the boiler, while on the other there is a comparatively cool cell, which after being charged must at first distil a large volume of green gases. These should obviously be caused to intermingle with gases at a high temperature to insure complete cremation, instead of which they come into immediate contact with the comparatively cool boiler surfaces.

The best arrangement is that in which a high temperature is maintained at all times in each cell, the combustion chamber being always fed with hot gases and providing a place for the final completion of the combustion in addition to the work actually done in the cells themselves. Thus in one type of destructor there is a continuous grate 20 feet long by 5 feet wide provided with four ashpits, and four charging doors arranged along the side, one-fourth of the cell can be clinkered and charged at a time, and three-fourths is always at work. This insures a high temperature in the combustion chamber, besides compelling the green gases from all except the last section to pass over the incandescent beds of one or more of the active sections.

Another feature which should be observed to aid in the maintenance of high furnace temperatures is the provision for charging the refuse in small quantities at frequent intervals. The difference between feeding refuse in small quantities into a hot and active cell and the dumping of a heavy charge into a cool and idle cell needs only to be mentioned to be appreciated.

As an additional element in the maintenance of a high temperature the use of heated air should be considered. By the use of a regenerative system, in which the incoming air is heated by the discharge gases, a most beneficial effect may be produced in promoting rapid ignition of the charge and an easy continuity of high temperature. This is especially important when there is much moisture in the refuse, either as a matter of local conditions or because of rainy weather.

The question of charging is discussed by Mr. Goodrich in an interesting manner. There is no doubt that it is desirable to have the refuse, always more or less offensive, delivered into the destructor cells with as little delay as possible, but when it is dumped in at the top in quantities of one to two tons at a time the combustion must necessarily be checked. At the same time the feeding of small quantities at a time by hand through ordinary firing doors admits cold air and tends to retard combustion to some extent, although this is the method preferred by Mr. Goodrich. A satisfactory method of continuous mechanical firing, which will handle the varied forms of refuse which come to a destructor, still remains to be devised, although it seems as if some modification of the travelling chain grate might be found to answer. The question of increased cost of mechanical firing, alluded to by Mr. Goodrich, is a serious one, and it undoubtedly is necessary that a satisfactory form of mechanical feeding device should also enable some labour-cost to be reduced.

It will be observed that in all this discussion nothing has been said as to the power-generating end of the plant, but this should always be given the second place, the prime object being the disposal of the refuse.

"It has been said that thorough cremation and really efficient power production are not compatible, and that they cannot take place coincidently; extremists have told us that if due attention is given to the primary purpose of the destructor, it will be of little service for power production. Seriously as this has been urged, to the detriment of useful combination, it is an argument which will not stand. It is true that if the steam boiler were placed in the very best position for heat absorption the destructor would be inefficient as a destructor, but it is equally true that the destructor, which is most satisfactory as a destructor, is the one which is so designed that the products of combustion are subjected to immediate high temperature contact, and of

sufficient duration to secure their perfect cremation. In this process a large volume of high-temperature gases is produced which passes to the boiler, and that continuity of high temperature, which is of the utmost value from a sanitary standpoint, is at the same time the justification of the destructor as a power producer."

An important feature in connection with the combination of destructors and generating stations is the complete separation of the electrical portion of the plant from the destructor. Even with the utmost care there will be a considerable production of dust which is of a very penetrating character, and hence the destructor should be separated from the power house by a high and thick wall, and every precaution taken to prevent the dust from causing trouble with the electrical machinery. The entire works should be under the supreme control of a competent engineer, who should have charge of the electrical plant, and command the operatives of the destructor plant, division of authority being a serious impediment to satisfactory results.

A serious difficulty to the success of a combined destructor and electric plant lies in the fact that the current is in most cases used mainly for lighting, so that the power is all required during the comparatively short portion of the day. If the plant could be maintained in continuous operation for 24 hours a day, much better results, both as to efficiency and completeness of destruction could be obtained than when operated for but a short period at a time.

If power supply and tramway service can be added to the lighting, so that the load may be fairly well distributed, such an arrangement is much to be desired, otherwise the plant must be much larger, in order to deal with the entire day's refuse in a small portion of the time.

THE STRENGTH OF RAILS.

EFFECTS OF SEGREGATION UPON THE STRUCTURE AND STRENGTH OF STEEL RAILS—CAUSES AND REMEDIES.

Mr. Thomas Andrews—Society of Engineers.

THE increasing importance of strength and soundness in rails and the very serious consequences which may follow unforeseen defects, renders the paper upon segregation, recently presented before the Society of Engineers by Mr. Thomas Andrews one demanding serious consideration. The chemical tests may show the material to be in compliance with specification requirements, and tests of certain specimens may give satisfactory results, and at the same time the segregation of the combined carbon and other elements may introduce local weaknesses of a serious character. The paper of Mr. Andrews discusses the existence of such conditions, and endeavors to show their causes and possible remedies.

The investigations of Mr. Andrews revealed the existence of segregation at various points in the transverse section of rails, especially at the junction of the head with the web. Such segregation is productive of uneven physical structure, and also of initial internal stresses liable to promote fracture under concussion or vibratory stress. Thus the tabulation of a number of investigations showed that as between the top of the rail head and the central area of segregation near the centre of the rail head, the carbon had segregated to about 59 per cent., the silicon to the extent of 47 per cent., the manganese to the extent of 8 per cent., the sulphur as much as 60 per cent., and the phosphorus to 46 per cent.

In other instances still greater differences in local constitution appeared. Thus, in another group of analyses of drillings, the most congested and concentrated portion of the segregation was found to be situated at the junction of the rail head with the web, in the central portion of which the combined carbon was found as high as 0.70 per cent. This showed that a maximum segregation to the extent of more than 133 per cent. existed in this part of the rail compared with the combined carbon found near the outer and other portions of the top and bottom part of the rail. The situation of this nucleus of segregation, at the junction of the head with the web, a place where great strength should be found, indicates the serious action of segregation in pro-

moting variable physical properties, resulting in a material reduction of the resisting strength of segregated steel rails.

In order to show more effectively the nature of the effects of segregation upon the structure of the material, the methods of metallography were utilised, portions of the metal being polished, etched, and examined under the microscope. Photographic reproductions of one of the effects thus obtained accompany the paper of Mr. Andrews showing very clearly the difference between the normal micro-structure at that of the segregated portions. In the latter examples not only is the segregated structure indicated in general, but details of the constitution are clearly shown.

Thus it is clearly seen that the segregated condition of the combined carbon and the micro-segregation of the sulphide of manganese and iron and other impurities produced the numerous flaws in the structure which were apparent. In some instances it appeared that the local presence of an excess of manganese interfered with the uniform crystallisation of the carbide of iron areas; in other cases the locally segregated condition of the combined carbon was found to produce brittleness, owing to the lack of a uniformly surrounding and interlocking mesh-work of ferrite. The extent to which segregation may weaken a rail will be understood when it is seen that in some cases no metallic contact was found to exist across the whole thickness of the web.

Such conditions occurring in cross sections of rails, it is evident that longitudinal areas of segregation may occur, and in examining this portion of the subject the cause for segregation appears to be found.

"The segregated state of the chemical constituents sometimes observed in steel rails appears chiefly due to the primarily segregated condition occurring in the top part of the rail ingot. During the slow cooling of ingots, the impurities, such as sulphide, phosphide and silicide of iron and manganese, which freeze or consolidate at lower temperatures, remain liquid or semi-plastic for a longer period of time than the metal itself, and in course of the consolidation of the metallic mass the above impurities, being of less specific gravity, gradually liquate towards the top of the ingot and there chiefly and finally consolidate. Local segregation of the carbon contents also frequently occurs. The impurities appear to liquate towards the central longitudinal axis of pipe of the ingot, near the summit of the ingot, and disseminate themselves amid the intercrystalline spaces of the primary crystals of the steel, and in the vertical transverse section of the finished rail these parts of the ingot are mostly found at the lower part of the rail head, adjacent to the junction of the rail head with the web.

"It will therefore be seen that the top of the ingot is likely to be the place where the greatest local segregation of impurities occurs. There the impurities are more massed together, and in this situation it is probable that the greatest segregation or dissociation of the chemical elements from mass uniformity takes place. The abnormal local concentration, or local aggregation of the chemical elements is thus accounted for. On the rolling out of the ingot into a finished rail this concentrated aggregation, or zone, becomes extended along the interior longitudinal axis of the rail, and in that end of a rail representing the top of the ingot the greatest tendency to internal weakness in segregated rails will be found. The term longitudinal segregation therefore appositely describes such a condition in the composition and structure of a segregated rail."

It has long been understood that the "piping" of ingots makes it desirable that the ends of rails should be cut off, in order that only sound structure may remain in the completed product. The investigations of Mr. Andrews show, however, that a much greater length should be cut off than has heretofore been the practice.

A still better plan may be found in the cutting off of the top of the ingot itself, to ensure soundness and freedom from both segregation and piping voids in the finished rail.

An additional point of interest has been the indication afforded of the relative extent of the segregation of the respective chemical constituents in steel rails, near the end of a rail representing the top of an ingot.

Analysis show that sulphur and phosphorus appear to have the greatest tendency to segregation, and afterwards carbon, though in some instances carbon is capable of heavily segregating. Silicon does not so frequently appear to have segregated heav-

ily, though in some instances it has been observed to have done so. It does not, however, appear that an absolute rule can be established, as local and other special circumstances may induce varied segregated formations.

In addition to the local internal transverse and longitudinal segregation, an external segregation has also been observed. This is also doubtless due to similar causes to those which produce the internal effects.

During the cooling of large steel ingots, in addition to local segregation, near the top of the ingot, there may sometimes be a further transverse migration of the carbon and other elements from the central axial part towards the exterior of the ingot. This tendency to external migration of the chemical elements is most likely to occur near the bottom or wider part of the ingot. Now, when such an ingot is rolled into a rail say 90 ft. long (which is finally cut in 30-feet lengths), that rail representing the bottom of the ingot is likely from the above cause to manifest a condition of local external segregation, as distinct from interior axial longitudinal segregation; whereas, the rail representing the top portion of the ingot would probably afford indications only of internal local axial segregation. Mr. Andrews thinks that the keeping of steel ingots for any lengthened period in soaking pits tends to promote local segregation of some of the chemical constituents.

If either internal or external local segregation arising from any cause is present to any considerable extent, it becomes a serious source of danger, leading to the sudden fracture of rails. An example is afforded by the fracture of a rail on a bridge of one of the chief English railways, which nearly produced a serious accident to an express train. A careful investigation was made into the cause of that accident, which was distinctly traced to an extensive external segregation of some of the chemical constituents of the rail at the point of fracture. Other cases of the fracture of steel rails which have occurred in main line service on various railways, have been investigated, and on careful examination it was found, in many instances, that the cause of the fracture was mainly due to the local segregation of some of the chemical constituents.

LONG-DISTANCE TELEPHONY.

EXPERIMENTAL TESTS OF THE PERFORMANCE OF THE PUPIN SYSTEM ON TELEPHONE LINES IN GERMANY.

Elektrotechnische Zeitschrift.

NEARLY two years ago there appeared in the pages of this Magazine an article from the pen of Professor M. I. Pupin, describing the principles upon which his important improvements in long-distance telephony are based. Since that time the system has been acquired by a great commercial company in America, and now, after successfully sustaining the ordeal of exhaustive practical tests, it has been adopted as a commercial system by an important firm in Europe. The tests which were made of the system in the United States were not given to the public, but with a more liberal policy the engineers who conducted the investigation in Germany, Messrs. F. Dolezalek and A. Ebeling, have been permitted to describe their investigations, and from a paper published by them in a recent issue of the *Elektrotechnische Zeitschrift* some account of their work is taken.

The principal feature of the Pupin system lies in the introduction of inductance coils at certain intervals, to reduce the damping constant of the line, the essential point being the fact that the distance between the coils should be a fractional part of the wave length of the alternating current used. Laboratory tests showed that the distance over which distinct telephonic communication can be held may be increased four times without any increase in the conductor, and hence without material increase in the cost of line, and it was to verify this great advantage that the experiments were made over existing telephone lines in Germany.

Messrs. Dolezalek and Ebeling give in their report the mathematical computations showing the relations between capacity, self-induction, and resistance per unit of length of line, and then proceed to show how the introduction of coils in accordance with the

theory could affect existing lines. This was made possible by the interested co-operation of the German Imperial Post and Telegraph Office. Two sets of experiments were made. The first of these was upon the cable between Berlin and Potsdam, a distance of 32.5 kilometers, this cable containing 28 double conductors of copper, 1 inch in diameter, provided with paper insulation, and fitted with protection of lead and asphalt. There were 14 of these conductors placed at the disposal of the experimenters, this enabling several multiples of the distances to be tried, while at the same time comparison could be made with the ordinary conductors under precisely similar conditions.

The only change which was made in the conductors for use according to Pupin's system was in the introduction of an inductance coil upon each conductor every 1,300 meters of length, there being 14 coils, one for each conductor, placed in a case and connected at the manholes communicating with the cable. Measurements of the original conductors with a current of 900 periods showed an inductance of 0.0003 henry per kilometer, and the dampening constant was 0.06. By introducing the inductance coils the self-induction was increased 200 times, and the dampening constant diminished to one-sixth.

The results of the experiments with this cable fully confirmed the theory as to the improvement in the transmission of speech. For single lengths of the cable the words were heard far more distinctly and at a much greater distance from the receiver than with the ordinary line. With an increase in the distance, obtained by using two or more circuits the ordinary lines showed a continual weakening in the sounds, until, with five circuits, corresponding to a distance of 162.5 kilometers, speech could hardly be distinguished, although on the lines equipped with the Pupin coils intelligible conversation could readily be maintained. Pushing the trials still further, the lines under test gave audible communication over a distance of 422.5 kilometers.

Experiments were then made with the overhead line between Berlin and Magdeburg, a distance of 150 kilometers. This line was composed of bronze wire, 2mm. in diameter, and before equipment it was compared with a similar line, 3mm. diameter, in the same service, but 180 kilometers long. In this preliminary trial the distinctness of speech over the smaller wire was naturally poorer than over the larger wire. Inductance coils were then placed on the 2 mm. wire, spaced 4 kilometers apart, this being done without interrupting the service, and the result was to render the communication much louder than over the larger wire.

Similar experiments were made over an overhead wire between Berlin and Potsdam, this wire being 2 mm. in diameter, and upon comparison it was found that the communications over this wire in normal condition were about the same as over the 1 mm. wire in the cable, when provided with the inductance coils.

The significant fact about these tests lies in the full proof which they afford of the correctness of Professor Pupin's theoretical computations. In every instance the introduction of coils of the size determined by calculation, at points indicated by the theory, resulted in either a great increase in the volume and distinctness of articulate sounds transmitted, or permitted a corresponding increase in the distance of transmission to be effected. As a result it has become altogether possible to provide entirely satisfactory telephonic communication between Paris and St. Petersburg, or between Berlin and London. An entirely new phase in the development of long-distance telephony has been inaugurated, and important results must certainly follow.

So far as the use of telephone communication upon submarine cables is concerned, the system is theoretically entirely applicable.

Its first uses in this department will undoubtedly be in the shorter lines in the Mediterranean, Baltic, and North Seas, so that telephonic communication may be established between London, Copenhagen, Stockholm, etc., with difficulty. Even if telephonic communication is not desired, the introduction of inductance coils will permit the use of high-speed telegraph transmitters upon submarine cables, thus greatly increasing their commercial value.

As to transatlantic telephony, the principal difficulty appears now to be that of placing and securing the inductance coils, but after experience has been had with shorter cables this mechanical problem will doubtless be overcome.

HIGH-SPEED PUMPS.

THE DEVELOPMENT OF MACHINERY FOR PUMPING WATER AT HIGH SPEEDS WITHOUT EXCESSIVE SHOCK.

La Revue Technique—Revue de Mécanique.

IN the design of machinery for pumping water the inertia of the liquid has always been an important element in the problem, and any sudden changes in direction or velocity of the column of water have been avoided as objectionable and injurious both to the machinery and the pipe line. The usual method of avoiding injurious action from inertia has been to keep within moderate speeds, ordinary practice being to use piston speeds not exceeding 0.40 metres per second (about 80 feet per minute), and not more than 60 revolutions per minute for rotative pumps.

During the past few years, however, these speeds have been greatly exceeded, and it is now well understood that with proper attention to certain details of design, danger from shock both with frequent strokes and high rotations can be avoided.

In a recent issue of the *Revue de Mécanique* this subject of high speed pumps is treated by M. Lecuir very completely, while in *La Revue Technique,* M. Diemer describes some examples of high-speed pumps exhibited at Düsseldorf.

As long ago as 1876 the firm of Farcot designed a pump which operated with a piston speed of 1.80 metres per second (about 350 feet per minute), this result being obtained by a judicious arrangement of the valves and care in the design and position of the air chambers, but notwithstanding the success which was obtained with this machine, the example was not followed at that time.

The real development of modern high-speed pumps dates from 1883, and is a direct consequence of the application of the indicator to the study of the action taking place in the interior of the machine, the indicator having proved as valuable in contributing to the improvement of pumps as it had previously been with the development of the steam engine. The use of the indicator as a means of solving this problem appears to have been first made by Professor Riedler, and in consequence of his investigations it was made clear that the future course of improvement in pumping machinery lay in the adoption of higher speeds, this permitting great reduction in dimensions, increase in capacity, and improvement in operation, due to the smaller masses in operation. Since that time the development of electric driving has created a demand for direct-driven pumps capable of being operated at high rotative speeds, so that the whole question has proved an important one.

The result of the investigation of the action of pumps by use of the indicator revealed several fundamental facts.

1. The influence of the size of the valve seat was found to be far less than had been theoretically supposed to be the case, even with valves which were almost completely balanced.

2. The heaviest shocks were found to be produced by the suction valves.

3. The shocks due to the valves were diminished in proportion as the level of water above the valves in the air chambers was reduced.

4. The magnitude of the shock varied with the weight of the valves.

It is evident that the velocity with which a pump can be operated depends upon the conditions which are necessary to maintain a continuous column of liquid, and that this also involves the necessity of having the valves operate regularly and with a minimum of shock.

Theoretically the valves should operate automatically at the moment when the piston reverses its direction. The movement of the piston, together with the column of water, has gradually been brought to rest; the pressure upon the valve has been gradually diminished, and it should reach its seat just as the plunger attains the dead point.

As a matter of fact these theoretical relations do not occur. The valve is still at a considerable distance from its seat when the motion of the plunger is reversed, and the delay which occurs in its closing produces a shock which depends upon the dis-

tance of the valve from its seat, and upon the mass of water which is compelled to make a reverse movement.

Various methods have been suggested to avoid this objectionable action. The most obvious plan is to have the valves operated by positive mechanical connection with the moving parts of the machine, so that they can be set to close at any predetermined point, in a manner similar to the valve gear of a steam engine. This was done by Corliss in a sewage pumping engine at Boston, and a similar construction has since been used with much success by Riedler in various parts of Germany and elsewhere. Riedler has designed pumps operating at 80 revolutions per minute and with a piston speed of 3.45 metres per second (about 680 feet per minute), delivering 16 cubic metres of water against a head of 188 metres, without shock.

While mechanically operated valves are a satisfactory solution of the problem for large and important machines, much progress has also been made in the design of smaller pumps, of which the valves are operated by the action of the water, and which can yet be driven at high speeds without shock. This has been made possible mainly by improved valve construction, and by judicious arrangement of air chambers. The actual weight of the valve itself has been found to be an important element in the retardation of its closing, and lighter valves, closed by springs, have been used. Especial care has been taken with the arrangement of the suction valves, and air chambers on the suction side have been found to be most effective, when properly placed.

M. Lecuir illustrates the importance of the proper action of valves and air chambers by an analysis of a number of pump indicator diagrams, and shows several forms of valve construction which have proved satisfactory in minimising shock at high speeds.

An excellent example of such a form of express pump is found in M. Diemer's description of the Klein pump, exhibited at Düsseldorf, this pump delivering water against a head of 35 metres when running at 170 revolutions, while similar pumps have operated against heads of 60 metres, at a speed of 200 revolutions.

ELECTRICITY IN RAILROAD SHOPS.

METHODS OF EMPLOYING ELECTRIC POWER TO THE HIGHEST ADVANTAGE FOR ECONOMY AND CONVENIENCE OF DISTRIBUTION.

L. R. Pomeroy—Central Railway Club.

ELECTRIC transmission of power is now coming to be extensively considered as a desirable method for use in machine shops and manufacturing establishments of all kinds, but in order that its advantages may be fully secured it is desirable that any installation should be made with due regard to the character of the establishment. Thus for some factories the group system offers especial advantages, while in other separate motors for every machine are preferable. Questions of wiring, voltage, kind of motors, etc., may often be best decided according to the methods of work and the nature of the loads, and in every case expert judgment should be passed upon the general arrangement of any installation.

In a paper recently presented before the Central Railway Club, Mr. L. R. Pomeroy discussed the considerations which should apply to the use of electric driving in railroad shops, and as these are similar in many respects to general machine works, his remarks are of wide application and value.

"The mere economy of transmission is one of the least reasons or advantages to be gained by electric driving, as the mere cost of power is but a small proportion of the total cost of operating the shop. The cost of fuel used, on the average, is not over 3 per cent. of the cost of the article produced (labor and other items, in which time is a factor, representing about 47 per cent., and material the other half). Thus it is patent that the power that goes into the product is a small item in itself, and any saving we may effect in that power is not very important. But if, by introducing a system that effects even a small saving in the cost of power, we can produce a saving of from 5 to 50 per cent. in the cost of product

turned out, a saving many times as great as the initial saving which brought it about, the subject becomes interesting and worthy of careful consideration. Notwithstanding the foregoing, the power question is worthy of consideration, and what follows is offered as a brief suggestion covering this phase of the question.

"The loss of power from shafting is constant, as long as the engine is running, whether one machine or a hundred be in operation, while the loss of electric transmission is a percentage of the actual power used. For all mechanically driven shops the friction load is a very large percentage of the average load. The friction load depends upon the condition of the shafting, speed, size and number of belts, and the alignment of hangers."

Mr. Pomeroy takes a practical example, and plots curves showing the relation of efficiency to the magnitude of the load, with data enabling mechanical and electrical driving to be compared, the result showing that with electric driving the efficiency is about 68 per cent. at half load, as compared with 30 per cent. for mechanical transmission, while at full load the electrical transmission reached 74 per cent. and the mechanical drive attained only 60 per cent. This gain, however, cannot be expected unless the electrical machinery is carefully selected, although of course an efficiency of 60 per cent. for mechanical transmission is not to be had unless shafting is carefully aligned, belts kept in good order, and lubrication properly maintained, so that both systems are alike in this respect.

A great element in transmission losses is the intermittent character of the load. When the load is maintained continuously at the maximum, a fair efficiency can be secured with mechanical transmission, but such cases are unusual. With electric driving, however, the irregularities in the demand for power have far less effect upon the efficiency.

"There is no consumption of power when the motor and machine are not in operation. There are no power losses when the motor is not in use; no so-called dead load losses, due to mechanical friction of the shafting system; no transmission losses in the line when the electric current is not required. In addition to the foregoing losses due to direct mechanical transmission, there are further losses due to indirect transmission; namely, when the shops are driven by separate engines, each receiving steam through long pipes running from a central plant.

"Loss in steam pipes is frequently the most serious of all, and many times a continuous, loss, night and day. When the pipes are lagged—as laggings in general possess various degrees of efficiency, roughly speaking—the condensation loss amounts to an equivalent in steam of half a ton of coal per annum per sq. ft. of uncovered pipe surface if continually under steam and exposed to the atmosphere, while with the best lagging, the equivalent is one-sixth of a ton.

"When the engines are small and scattered about the works they may consume all the way from 50 to 250 lbs. of steam per indicated horse-power per hour. As it is possible to generate electric power in one centrally located power house, with generators driven by steam turbines of moderate size and at greatly reduced first cost over equivalent reciprocating engines, with a guaranteed steam consumption of from 20 to 22 lbs. per k. w. hour, or 12 to 17½ lbs. per i. h. p., the foregoing figures are significant."

Mr. Pomeroy sums up the advantages of electric driving in much the same general manner as has been done heretofore, laying especial emphasis, however, upon the value of features other than mere efficiency of power transmission. Thus, cost of maintenance, convenience of arrangement of tools, facility in additions and extensions of plant, and convenience in speed variation, all are shown to possess great value in the ultimate efficiency of the plant, and all should be considered in replacing mechanical transmission methods by electricity.

Coming to the especial advantages of electric power in the railroad shop Mr. Pomeroy takes a concrete example.

The Baldwin Locomotive Works claim that the introduction of electricity made a direct saving of 20 per cent. in the pay rolls and 40 per cent. in shop area. The introduction of cranes, made possible by the introduction of electricity, enables the reduction of the laboring force by one-tenth of that previously employed. The advantages of cranes are a legitimate claim in fa-

vor of electricity, for the reason that expeditious and efficient cranes are impossible without electricity.

"Presupposing a typical railroad shop comprising several buildings, there are three ways in which electric power may be applied, each varied in the amount of first cost, and the corresponding advantages thereof are directly proportional:

"First—The simplest and most elementary method would be the erection of a central power station, conducting the current to each building and operating by a single motor of sufficient capacity to run the shop.

"Second—The same as in the foregoing, but apply group driving in each shop by a motor for each department or to economical sections of main line shafting. This latter form, like the first, would not demand any re-arrangement in location of tools.

"Third—Same as in case one, but rearrange the tools with reference to departments and locations, providing for a given sequence of work through the shop. Remove overhead shafting and thereby make possible the use of electric cranes where advantageous. Such shafting as necessary to be retained can be carried on brackets to side walls or main columns. Arrange for such a combination of group and individual drives, as will place constant speed tools as far as possible in the groups, and provide individual drives for such tools as demand variable speed or are more or less isolated or used intermittently.

"A shop manager commencing by adopting plan number one would soon see the advantages of plan number two, and the experience with plans one and two would readily lead to a recommendation of plan number three. In addition to the general advantages of electric shop driving, the central power station can provide for shop, station and yard lighting, operating turntables, water and coal stations, without addition to the power station force."

THE CONTRACT SYSTEM OF WAGES.

INDUSTRIAL METHODS OF THE BALDWIN LOCOMOTIVE WORKS—CONTRACT AND PIECE-WORK SYSTEMS IN PRACTICAL USE.

American Academy of Political and Social Science.

ONE of the largest and most important industrial establishments in the United States is the Baldwin Locomotive Works, and hence such a complete exposition of its industrial and wage system as that given by Mr. Converse in the *Annals of the American Academy of Political and Social Science* demands attention as an important contribution to the subject of applied industrial economics.

Mr. Converse states the gist of the whole question in his opening paragraph:

"The secret of the success of the American manufacturer, that which enables him to turn out a uniformly good article in a short time and at a low cost, lies in the energy of his production. The chief element in this production is the personnel, the character and method of treatment of the labor employed. The American manufacturer has realized the fact that to get the best result and the largest output from his plant the interest of his laborer and himself must be in harmony. This is not a sentimental theory but sound business policy. It is to the advantage of the employer to pay high wages for good work quickly and accurately done, rather than to pay low wages for slow and slovenly work. The laborer does better when he realizes that his work is appreciated and that increased effort and diligence meet with substantial recognition and reward. The workman is encouraged to exercise his brain and is given extra pay or promoted for having done something or discovered something to the advantage of his employer."

From the first organization of the works, about fifty years ago, the product of the works was arranged according to a classification which, with necessary modifications has been continued down to the present time. In this system the various types of engines built are grouped according to certain salient features involved in their construction, primarily based upon the number and arrangement of the driving and truck wheels, and the size and number of the cylinders. The general principle resembles that used in botanical scientific nomencla-

ture, the locomotives being reduced to their genus and species by means of a combination of figures and letters which indicate the total number of wheels under the engine, the number of driving wheels, the diameter of the cylinders, and whether they are single-expansion or compound. All the work upon each type of engine is kept under this unit system of classification, including designing, drawing, purchase of materials, and time recording.

"A further advantage of this unit system of production appears in the accounting department. Two sets of books are kept—a financial and a manufacturing set. In the financial department accounts are kept of sales, purchases and expenditures. In the manufacturing books a separate account is opened with each locomotive and the material entering into its construction and the labor expended on it are charged against that locomotive. At the end of the year these two sets of books must balance each other. By this method the actual cost of each locomotive is obtained with accuracy and, allowing for fluctuations in price of raw materials, correct quotations can be made for any class of engine.

"It is upon this unit system of locomotive classification, by means of which the identity of each locomotive is preserved, that the system of the labor organization and management of the establishment is based."

Since about thirteen thousand men are employed at the establishment, the question of labor management is an important one, and the variety of work carried on renders the shop more general in its character than might at first be supposed. Thus the skilled labor includes iron-founders, brass-founders, blacksmiths, machinists of all kinds, woodworkers, tinners, carpenters, painters, copper-workers, plasterers, and sheet-iron workers. About two-thirds of the men are skilled mechanics and one-third unskilled laboring force. These men have their wages reckoned by the hour, the average being 30 cents per hour for skilled labor and 16 cents for unskilled labor. By far the greater portion of the work, however, is paid for at piece rates, the unit system of production making it desirable that all work should be turned out by the piece.

"In the Baldwin Locomotive Works, two forms of piece-work are represented, viz: Piece-work proper, where the workman is paid according to the quantity produced; and a contract system, where sub-foremen, called contractors, are entrusted with the execution of a portion of the work on a locomotive; for example, the entire construction of the cylinders, or the erection of a certain number of tanks. The contractor has entire charge of the job, seeing that the raw material is delivered in time, that the men are prompt and diligent, that tools are in repair and machines do not break down. The contractor is paid for the job, the firm paying directly to each workman for the labor on the job. The contractor cannot, therefore, get more than the amount due him on any one job by curtailing the wages of his labor. The contractor is a piece-worker on a larger scale. As he is paid by the job, he has an incentive to turn out his work as quickly as possible and to get as much work as possible out of the men under him."

Apart from the incentive to the men to make the maximum output under the piece rate system, the saving in time in other respects is noteworthy. Time is economized everywhere in handling materials, and in passing work in progress from one department to another, and when any interruption or breakdown occurs the workmen are more interested than any one else in a speedy resumption of operations.

"The contract and piece-work systems insure quantity of product; a rigid system of inspection insures quality of product. In order to insure good workmanship an extremely rigid system of inspection is maintained and contractors and piece-workers are held to strict account if the quality of their work falls below the standard.

"Another feature of the piece-work system, which is at the same time an advantage and a disadvantage, is the specialization which it naturally entails. In the kind of machine work done at the Baldwin Locomotive Works, the same operation is performed over and over again many times. The piece-worker, doing the same thing repeatedly, soon finds out the best and quickest way to do the work and, as he can make more money doing his specialty, he is naturally unwilling to be shifted to another machine or another class of work."

Since the high degree of specialization

tends to prevent the development of general mechanics, the company has established a special system of apprenticeship, under moderate pay, but with especial opportunities for learning the trade.

"The policy of the firm is to make the interest of the men identical with its own. Hard work is required but high wages are paid, ingenuity is encouraged, and intelligent and faithful work is liberally rewarded. Piece-rates are seldom cut, and then only on account of the introduction of a time-saving tool in which case the workman shares in the gain accruing. The policy is to maintain a uniform piece-rate for all the men doing a certain class of work. If one man shows especially marked ability, he may be shifted to another job; usually being made a contractor or sub-foreman. The policy of the establishment is to make promotions from within, foremen, bosses or superintendents are not imported. There are no hereditary rights to important positions."

The criterion of the success of the system is the fact that it has persisted through a long period of years, and that labor troubles are practically unknown in the works. Many of the men occupying high positions in the establishment, and several members of the firm have risen from the ranks of the workmen, while the commercial development of the works is sufficient evidence of the wisdom of its management.

THE THEORY OF ELECTRONS.

MODERN RESEARCHES INTO THE THEORY OF THE NATURE OF ELECTRICITY AND ITS RELATIONS TO MATTER.

Sir Oliver Lodge—Institution of Electrical Engineers.

THE applied science of engineering has always been obliged to proceed in its work with but an imperfect knowledge of the materials with which its work is done, and with but few exceptions the theory has been developed largely from the data acquired in the course of practical work. When, by some especially brilliant deduction, a scientific man produces from theoretical considerations alone, a detailed practical application of scientific principles, the feat is hailed with an admiration which clearly shows its unexpected nature, and in many instances the really practical work of such men as Faraday, Maxwell, Mayer, Thomson and others, is often considered mere theory until some subsequent experience shows how practical it really was.

Thus, electrical engineers have pushed their practical work to a high state of development, producing generators and motors possessing efficiencies far surpassing anything which has been attained in the older science of steam engineering, while at the same time using the old and acknowledged imperfect theories of electricity, and constantly admitting their ignorance of its true nature. At the same time the physicists have been active in studying the observed phenomena and deducing from the results of this practical work theories which accord more and more completely with the facts. The result has been the development of the hypothesis of electrons, a step toward a working theory of electricity which has hardly been appreciated by practical electricians because of their imperfect acquaintance with its principles.

For these reasons the important paper of Sir Oliver Lodge, upon the subject of Electrons, presented before the Institution of Electrical Engineers, and published in full in the *Electrician*, demands especial attention, placing, as it does, the elements of theory in a manner adapted for the intelligent study of the general reader as well as the student of physics.

Starting with the electrostatic conditions surrounding a charged sphere, with its radiating lines of force, the phenomena which accompany its movement through the ether are considered; the combination of lines of electric force and the motion, producing new lines of magnetic force, these latter, unlike the lines of electric force, being curves. The magnetic field comes into existence when the charged body begins to be moved, and dies away as it comes to rest, its strength depending upon the potential of the electric charge. When the motion of the body is being accelerated there is an increasing current, with self-induction and an

electromotive force which opposes the motion; when the motion is decreasing there is an electromotive force in the same direction, tending to increase the motion. The phenomena are similar in character with those of inertia, and it is not improbable that they are identical with it. Whatever inertia a material sphere may have considered as matter, it will possess more when it is charged with electricity, and the amount of extra or electrical inertia is proportional to the electrostatic energy of the charge.

Now in order to confer upon any electric charge an appreciable mass, it is necessary to make its potential extremely high—that is to concentrate it upon a very small sphere. By observation, however, the charge on an atom, as determined in electrolysis, is so small that if it were distributed uniformly upon a sphere the size of an atom its potential would be only about 3 volts, and the inertia of a body possessing the corresponding energy, when moving at the speed of light, the minimum speed at which radiation could be produced, is so minute that the charge, when distributed over an atom would add no appreciable fraction to its apparent mass. If, however, the size of the sphere be still further diminished, the potential will be correspondingly raised, so that the requirement for the existence of a charge corresponding with observed effects is that of a body much smaller than any existing atom.

Taking the charge of a monad atom as the unit electric charge, we have the possibility of considering the charge apart from the atom as a natural unit of electricity. The atom with its charge is called an ion. The charge, considered alone, without its atom, is called an electron, or natural electrical unit. This is the smallest known portion of electricity, of which we can have multiples, but of which it is impossible to have fractions. Every atom carries a definite charge, the monad atom one, the dyad atom two, etc., but none of them carries a partial charge.

It is therefore seen that we have deduced, from the measured effects of electrical inertia, the probability of the existence of ultimate particles of electricity, so minute that they may pass freely between the spaces between the ordinary atoms of matter, and which in fact may themselves form the ultimate constitution of matter.

Already the modern theory of chemistry has become greatly modified by reason of the study of the electron hypothesis, and it is possible that from it also it may become possible to explain the phenomena of gravitation and cohesion. The lines along which such investigations must be carried are well indicated in the exceedingly able address of Sir Oliver Lodge, and in spite of the profound nature of the reasoning, it is a most fascinating phase of that pure science which may become the practical work of the impending future.

SUPERHEATED STEAM.

A REVIEW OF CURRENT PRACTICE IN THE UNITED STATES IN CONNECTION WITH STEAM ENGINE DESIGN AND OPERATION.

Ernest Foster—Engine Builders' Association.

THE advantages of superheating as a means of preventing condensation losses in steam engines are now well understood, and it is only an apprehension of mechanical difficulties which prevents a more general adoption of this obvious element in steam economy.

At the recent convention of the Engine Builders' Association of the United States, Mr. Ernest Foster discussed the question from the practical side, and some abstracts of his remarks may be found useful.

Mr. Foster distinguishes between moderate superheat, and highly superheated steam, and shows the extent to which superheating may conveniently be carried without involving operative difficulties with engines designed substantially in accordance with present practice.

"By a moderate superheat, we mean from 100 to 150 degrees at the boiler, which should give in the neighborhood of 100 degrees at the engine and be sufficient, with proper protection, to carry the steam nearly, if not quite, through one cylinder without condensation. If the engine is compound, the steam, having lost its superheat at the terminal point of the high pressure cylinder,

is re-superheated about 100 degrees in a reheater between the high and low pressure cylinders and again loses its superheat while expanding into the low pressure cylinder, arriving at the point of exhaust with the temperature of saturation. This arrangement may be considered at the present time as the best which can be proposed. The amount of superheat is so moderate as not to require anything more than good construction for modern high steam pressures."

When higher degrees of superheating are used it will generally be found necessary to make modifications from the usual details of engine design. On the high-pressure cylinders of compound engines at least, sliding valves should be avoided, and poppett valves employed, as the high heat is apt to distort the valve and seat and cause binding with valves of the Corliss type, although Mr. Foster believes that properly designed Corliss valves may be used at high temperatures. At the same time the advantages of extremely high superheating are not such as to render its use desirable, except under special conditions. Probably the best method of employing highly superheated steam is in a steam turbine of the De Laval type in which the absence of valves and the freedom from lubrication remove the principal difficulties otherwise encountered.

"In the present state of the art it would seem that the condition most attractive to American engine builders would be one of moderate superheat. We thus confine ourselves to a conservative policy and avoid the necessity for making any special provision for extremely high temperature. We use lubricants, and gaskets and packing which may be obtained in the open market at a reasonable cost, while at the same time we avail ourselves of such positive and direct benefits of superheating as: Dry steam in the pipes and throughout the engine, elimination of separator, low steam consumption per unit of work done, smaller steam pipes and ports, simplified system of steam jackets, greater amount of work done per boiler capacity, and efficiency at light loads. These are all practical and common sense improvements, and are of such proportion as to fix our attention."

An important element in the question of the introduction of superheated steam is found in the modifications possible in the steam ports and pipes. The absence of entrained water and the diminished density of an equal volume as compared with saturated steam permits a reduction of about 20 per cent. in the size of the steam pipe; and the velocity of the steam in the pipes should be kept up to about 6,000 feet per minute.

"It must not be considered necessary to make any very extensive preparations for the use of superheated steam, it may almost be said that the requirements are merely in the line of good practice, and, as such, should be inaugurated in any event.

It is important to have the joints of the steam pipes firmly made and well bolted; corrugated brass gaskets are usually found very satisfactory with superheated steam. Provision must, of course, be made for the expansion and contraction of the steam lines to a somewhat greater extent than ordinarily, and the steam pipes as well as the flanged unions should be covered with a good non-conducting material in a thick layer. It is important to have the flanged unions covered as well as the pipe. With proper precautions of this sort and with a velocity of steam in the pipes of from 4,000 to 6,000 feet per minute, the drop in temperature per foot of run may easily be kept down to 1 degree in 6 or 7 feet of length."

The manner in which Mr. Foster views superheating is practically what might be expected from the conservative position of a modern builder of steam engines of good design, or of an engineer following good standard practice. Superheating was tried many years ago, and failed to come into use simply because the engines of that day were not suited for it. Now steam engineering practice has advanced, and moderate superheating may be used with success and advocated with safety, since it does not involve any radical changes in design. With the more general introduction of the internal combustion engine for all sizes and services, the question of high cylinder temperatures will become a matter of common practice, while, if the steam engine is to hold its own in competition with the more economical motor something must be done to advance its performance.

Higher pressures and higher temperatures appear to be the only resources left in the line of improvement in steam using prac-

tice, and the necessary modifications in engine design will surely come with the demand. It is more than probable that the reciprocating engine with its close fits, and sliding surfaces, will in many instances be replaced by the steam turbine, driving the direct-connected dynamo, the power being distributed and applied electrically to the best advantage, and with greatest convenience.

THE ENGINEER OF THE TWENTIETH CENTURY.

HIS RELATION TO PUBLIC AFFAIRS AND TO INDUSTRIAL ENTERPRISE—UNITED ACTION AND CO-OPERATION ESSENTIAL.

Chas. F. Scott—Engineers' Club of Philadelphia.

AT the twenty-fifth anniversary of the Engineers' Club of Philadelphia, Mr. Charles F. Scott spoke of the engineer of the twentieth century and made some suggestive points with regard to the extention of the scope of engineering and its growing connection with industrial progress in a very interesting manner.

Referring back to the work of the engineer in the last century, Mr. Scott showed that the great discovery of the nineteenth century was co-operation, the effectiveness of concentration, the efficiency of largeness. Says he:

"Compare the old days of the hand loom in the home, of the shoemaker at his bench, of the individual oil well and coal mine, of the small railroad and of the small factory, —compare these with modern methods, with their unbounded possibilities—possibilities of good and possibilities of evil; of good, because the engineer has provided the means for doing the world's work more efficiently; of evil, because the social, the industrial, the commercial systems have not kept pace with the advance made by the engineer—for they are tainted by injustice and by selfishness."

Viewed in the light of what has been done, the work of the engineer in the present century may be predicted with partial accuracy at least. He is to become the great factor in adjusting and operating the intricate mechanism of a new civilization. He is to deal with large affairs in a large way. He is to be closely related to every department of modern life. He will be advanced to administrative positions for which his knowledge and his training peculiarly fit him. Even at the present time we see this phase of his career developing. The heads of great railways, of large commercial undertakings, of vast enterprises of today are in many cases engineers who from their proved capacity to manage men and materials in special lines have been entrusted to control broader and more general affairs.

All of this development means a fuller recognition of the position of the engineer by the world at large. Even yet the so-called learned professions fail to realise that the engineer may be a man of higher educational attainments and wider social grasp than is possible under the old scholastic limitations. It has been well said that of the three professions, the lawyer thrives by our quarrels, the physician by our diseases, and the clergyman by our sins; but the engineer in his work appeals to the higher and broader benefit of the human race by directing the great sources of power in Nature to the use and convenience of man.

An important element in the progress of the engineer in the nineteenth century has been the work of the various engineering societies, and this is certain to become of still more influence and effectiveness in the present century. This phase of the life of the engineer will also doubtless be modified in the light of general progress. The present state of affairs in this respect Mr. Scott well likens to the relation of the original American states before the union was effected. By forming a union the several states which now form the great nation have lost nothing of their individuality, while gaining immeasurably in power and effectiveness.

Already there has been some indication of the manner in which this important step forward may be accomplished. During the past year the four great national societies united in the foundation of the John Fritz medal, as an honor to one of their own number and an incentive to individual effort of all their members. One of the most

interesting things about the conduct of that undertaking was the revelation which it made to all of the unity in purpose and methods of the several societies. Mr. Scott but expresses the thought of many of those who took part in that foundation, when he said:

"In the vision of the future may we not discern a reflection of the John Fritz medal in the larger life of the twentieth century engineer? Methinks I see the outlines of the medal taking the form of a magnificent building, the capitol of American engineering. Into this home in the metropolis are gathered the great engineering societies from their scattered lodgings. Here is a great technical library, here are ample assembly halls and comfortable parlors, here are the headquarters of a score of lesser societies, affiliated in their work but restricted in their scope. I see all over the country innumerable local societies and engineering clubs, no longer isolated but joined together into one great combination. I see them affiliated with the national bodies—sometimes as local chapters—all together constituting a great union. There is individual freedom but general co-operation. The Engineering Congress representing all the engineering professions and supported by the great union of enginering societies, gives to engineers a rank consistent with the importance of their work; it increases the efficiency of the inter-relations among engineers. An eminent body, it is powerful in advancing the common interests of engineers, and it represents the engineering profession in its relation to other professions, to pure science, to education, to legislation, to public improvements and to the general welfare."

There is nothing to hinder the early realization of this thought but the inertia of the societies themselves, and with the growth of the progressive spirit, and the full realization that union in this broader plane does not involve the relinquishment of the slightest element of present independence, any such opposition must ultimately be overcome. Of all men the engineer has the least occasion to be jealous or suspicious, for he, more than any other has to deal with materials and conditions which permit of no deception or false assumptions.

"The men who are mastering the powers of nature will yet rise in the strength of united effort to meet the increasing responsibilities of the coming years. For it is theirs to build the foundation of the new civilization; it is theirs to establish material prosperity—the underlying condition for broader, fuller and higher life."

THE ENGINEERING DEVELOPMENT OF AFRICA.

PROGRESS OF RAILWAY CONSTRUCTION—REGULATION OF THE NILE—DEVELOPMENT OF MINERAL WEALTH.

Geological, Physical, and Political Studies.

AFRICA has been the field of many invasions, all of them military, and after each of these attacks there has been a lapse into barbarism and darkness. Now, however, a new order of subjugation has been commenced, an attack of a kind which has not yielded to the lapse of time in other parts of the world, and which can be depended upon to produce lasting results in the opening of the continent—the attack of the engineer. At the present day railways advance nearly as rapidly as the columns of an army formerly progressed, and where they go they stay. The extraction of the wealth of the earth enriches the country instead of impoverishing it as does the loot of the invader! while the fortifications which the civil engineer constructs to oppose and control the flood of great rivers provide a far greater protection to the land than any structure ever erected by his military associate.

The question of the engineering development of Africa forms the subject of more than one important article in recent issues of technical journals. In the *Revue Générale des Sciences* appears an extended study of the mineral resources of the continent, by M. L. de Launay, while in the *Zeitschrift des Oesterreichischen Ingenieur- und Architekten Vereines* Dr. Franz Ritter v. Le Monnier discusses the entire subject of the railways of Africa, present and prospective. The great Nile dam at Assouan has

been fully discussed in the British journals, notably in the *Engineer* and in *Engineering*, while industrial conditions in various parts of the continent have formed the theme of correspondence and discussion in many publications. To review all this mass of information would be far beyond our space limitations, but some of the salient features in this attack by the engineer upon the section of the world which has thus far resisted all other invasions may be found practicable.

So far as mineral wealth is concerned, it is known that Africa contains great riches, but until a geological survey can be made much depends upon conjecture. M. de Taunay gives a summary of the geology of the continent, so far as it is known at present, and shows that it may be divided into two main divisions: one of which consists in its latest strata of the carboniferous formation, covering horizontal strata of permo-trias, while the other exhibits principally formations of the tertiary period. These he examines at length, showing the difference between the alluvial deposits of the gold coast and the conglomerate formations of the Witwatersrand, and discussing the possible origin of the deposits and the necessity of further geological studies in this respect.

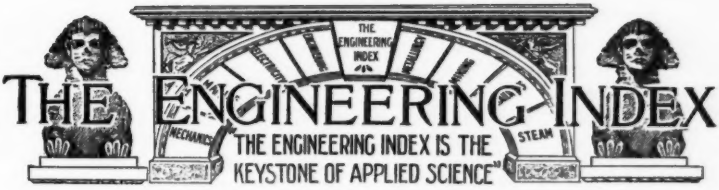
The Congo region, and in fact the whole equatorial portion of the continent appears to have no gold whatever, the auriferous regions appearing to be in two zones, one between 5° and 10° north latitude, and the other between 15° and 25° south. In the equatorial region the principal deposits are iron and copper, with traces of tin.

The formations of the Witwatersrand have been more fully studied than any others, and the whole of South Africa, up to the great lakes may be considered as possibly auriferous. Besides the metalliferous deposits extensive deposits of coal are indicated, and these will doubtless be developed hereafter. The northern portion of the continent, known more fully from earlier times, contains deposits of copper, zinc, and lead, as well as of nitrates and phosphate rock, these having been worked but superficially down to the present time.

The development of the natural resources of the continent, however, must depend largely upon transport facilities, and hence the progress of railway construction forms the most important element in the work. Already much progress has been made in this work. Dr. Ritter v. Le Monnier gives a summary of the state of the railways of Africa at the close of 1900, the total being 12,500 miles, of which nearly one-half is in British colonies, one-fourth in French colonies, and more than one-fifth in Egypt, the small remainder being in the German and Portuguese colonies, and on the Congo. These various roads all penetrate into the continent from the sea coast, and it is evident that such operations must do far more to open up the continent than any Cape-to-Cairo railway could do. The Uganda railway, the lower Congo line, and the proposed line across the continent, all should prove effective means of permitting that development which naturally follows the creation of transport facilities, and the connection of the interior with the coast.

Among the undeveloped resources of the continent of Africa there are numerous sources of hydraulic power, which, when equipped in the light of modern experience, should do much to aid in the work of subduing the country and making its natural riches available. These need only access, such as the completion of rail and water communication will provide, to render them most efficient aids in the work to be accomplished.

The completion of the Nile dam at Assouan has been the occasion of numerous articles, and it can be mentioned but briefly here. In fact it is a much more extensive scheme than the mere construction of a regulating dam across a river, even though the dam be a mile and a quarter long, and the river be the Nile. It means, in fact, the impounding of the waters of the Albert and the Victoria Nyanza, at the sources of the White Nile and of Lake Tana at the source of the Blue Nile, as main reservoirs, with the new storage reservoir above the dam as an artificial auxiliary. Constructed under the most difficult conditions, with the constant action of the river to be opposed, and with many local and unforeseen obstacles to be removed, the Assouan dam, and its supplementary barrage at Assiout to divert the water into the irrigation canals, forms not the least striking of the means by which the engineer is subduing the continent of Africa permanently to civilization.



The following pages form a DESCRIPTIVE index to the important articles of permanent value published currently in about two hundred of the leading engineering journals of the world,—in English, French, German, Dutch, Italian, and Spanish, together with the published transactions of important engineering societies in the principal countries. It will be observed that each index note gives the following essential information about every article.

(1) The full title,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published.

We supply the articles themselves, if desired.

The Index is conveniently classified into the larger divisions of engineering science, to the end that the busy engineer and works manager may quickly turn to what concerns himself and his special branches of work. By this means it is possible within a few minutes' time each month to learn promptly of every important article, published anywhere in the world, upon the subjects claiming one's special interest.

The full text of any article referred to in the Index, together with all illustrations, can be supplied by us. See the "Explanatory Note" at the end, where also the full titles of the journals indexed are given.

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BRIDGES.

Arch.

Kinematic Investigation of a Two-Hinged Semi-circular Arch (Kinematische Untersuchung eines Halbreisformigen Bogenträgers mit Zwei an den Kämpfern Gelegenen Gelenken). G. Ramisch. A mathematical study of an arch with hinges at the springings, using the elastic theory and the methods of kinematics. 2500 w. Zeitschr d Oesterr Ing u Arch Ver—Nov. 28, 1902. No. 52417 B.

The Monumental Bridge at Luxembourg (Le Pont Monumental de Luxembourg). M. Cart. A description of the great arch of 84 metres span; one half of which is already completed. Illustrations showing the state of the work are given. 3000 w. Rev Gen des Chem de Fer—Dec., 1902. No. 52452 H.

Foundations.

The New York Tower Foundations for the Manhattan Bridge. Briefly describes the work giving the specifications for the caissons. 2400 w. Eng News—Nov. 27, 1902. No. 52035.

Hinged Arch.

The Two-Hinged Arch. Edward Godfrey. An analytic method for finding the stresses in a two-hinged arch, based on

We supply copies of these articles. See page 817.

the "pull over E" formula, that is, the formula for finding deflections; with diagrams and table. 2200 w. Eng Rec—Dec. 27, 1902. No. 52576.

London Bridge.

The Widening of London Bridge. Describes the temporary work, which is of an unusual nature, and the way in which it has been carried out. Ill. 1700 w. Engng—Dec. 5, 1902. No. 52364 A.

Masonry.

Construction of the Blackwell's Island Bridge Masonry. An illustrated article describing the methods of work, materials, method of preparing and handling, etc. 4300 w. Eng Rec—Dec. 16, 1902. No. 52345.

Removal.

Removal of the Old South Tenth Street Bridge, Pittsburg, Pa. Willis Whited. Gives a brief account of the bridge and describes the method of removal. 1300 w. Eng Rec—Nov. 29, 1902. No. 52124.

Suspension.

The Construction of Suspension Bridge Cables. An editorial review of the history of cable construction, particularly the attempts to improve upon the parallel wire cable. 1500 w. Eng News—Nov. 27, 1902. No. 52034.

Swing Bridge.

A 128-ft. Wooden Swing Bridge Over Barnegat Bay, Mantoloking, Ocean County, N. J. Franklin Van Winkle. Brief illustrated description of a bridge having wooden draw span possessing novel features. 3300 w. Eng News—Nov. 27, 1902. No. 52032.

CANALS, RIVERS AND HARBORS.

Coffer Dams.

The Construction and Use of Coffer Dams (Des Batardeaux et de Leurs Epuisements). M, Arana. Discussing methods of construction of coffer dams in connection with river improvement works, and especially with the pumping of the water from them. 3500 w. Revue Technique—Nov. 25, 1902. No. 52428 D.

Dams.

A New Dam and Storage Reservoir at Amsterdam, N. Y. An illustrated description of a curved dam, 450 feet long, with a cement masonry core wall 63½ feet high, making a reservoir with an area of 180 acres and a capacity of 1,200,000,000 gallons. 1500 w. Eng Rec—Dec. 27, 1902. No. 52575.

The Assouan Dam and the Assiout Weir. A general history of these great reservoir works on the Nile, with illustrations. Serial Part I. 2000 w. Engr, Lond—Dec. 12, 1902. No. 52539 A.

The Aswan Dam. An editorial review of this great engineering work for regulating the flow of the Nile and supplying irrigation water. 3000 w. Engng—Dec. 12, 1902. No. 52564 A.

The Muscoot Dam in the Croton Valley, New York. An illustrated description of a masonry dam, 950 feet long, being constructed near the middle of the projected Croton Lake, so that the bottom of the upper end of the lake will not be exposed at low water. 1200 w. Eng Rec—Dec. 20, 1902. No. 52568.

Danube.

The Regulation of the Danube in Hungary (Die Regulierung des Donaustromes in Ungarn). Karl Grünhut. An exhaustive study of the various states of the river, with diagrams of the water levels and data concerning the regulation works. Three articles. 15,000 w. 1 plate. Zeitschr d Oesterr Ing u Arch Ver—Nov. 14, 21, 28, 1902. No. 52415 each B.

Floods.

Protecting a Railroad from Flood Currents. Day Allen Willey. An illustrated description of a piece of revetment along the Missouri River, which has attracted attention on account of the plan of construction, low cost, and permanent protection afforded. 1200 w. Sci Am—Nov. 29, 1902. No. 52045.

Ligthouse.

The New Beachy Head Lighthouse. Illustration and brief description of a recently completed lighthouse on the English Channel. 500 w. Sci Am—Nov. 29, 1902. No. 52043.

Overflow.

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Panama Canal.

Lake Bohio, the Summit Level of the Panama Canal. George S. Morison. An authoritative exposition of the project adopted by the American Isthmian Canal Commission for the control of the summit level. 4000 w. Engineering Magazine—January, 1903. No. 52485 B.

Tunis.

The Port of Bizerta (Le Port de Bizerte). Col. G. Espitallier. A description of the harbor of Bizerta in Tunis, showing the important improvements which have taken place between 1881 and 1900. Three articles. 7500 w. 1 plate. Génie Civil—Nov. 15, 22, 29, 1902. No. 52422 each D.

Weirs.

A Study of Hydraulic Coefficients (Eine Studie über Hydraulische Coëfficienten).

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H. Heyne. An examination of the various formulas for the flow of water over weirs, showing the discrepancies, and discussing the extent to which the usual coefficients may be used. 3000 w. Zeitschr d Oesterr Ing u Arch Ver—Dec. 5, 1902. No. 52420 B.

CONSTRUCTION.

Building Construction.

Influences Affecting Modern Building. Cyril Blackel. Read before the Inst. of Archts. of N. S. W., Sydney. Compares the materials in present use with those of one hundred years ago, discusses the sewerage systems, steel work, gas, electricity and other influences that have affected design. 3500 w. Archt, Lond—Nov. 28, 1902. No. 52169 A.

Columns.

The Dimensions of Centrally and Eccentrically Loaded Columns (Einige Bemerkungen über die Bestimmung der Abmessung exzeutrisch und Zeutrisch Beanspruchter Säulen). A. Ostenfeld. A review of Tetmajer's recent treatment of the subject, deriving coefficients for various sections. 2500 w. Zeitschr d Ver Deutscher Ing—Dec. 6, 1902. No. 52410 D.

Dredge.

Dredges for Levee Building. Enos Brown. Illustrated description of a giant dredger. The bucket holds 25 tons, and the boom is 155 feet long. 500 w. Sci Am—Dec. 20, 1902. No. 52394.

Fire-proofing.

Fire-proof Grain Storage Buildings. Illustrates and describes several types tracing the evolution of fire-proof tank elevators. 2800 w. Br Build—Nov., 1902. No. 52096 D.

Floor Construction and Fire-proofing in the Government Printing Office, Washington, D. C. An illustrated description of the construction work of this new building, which is being built under an appropriation of $2,429,000, which must include the equipment. 2000 w. Eng Rec—Dec. 6, 1902. No. 52244.

Floors.

Static and Dynamic Load Tests of De Valliere Fireproof Floor Construction. E. S. Powers. Explains the methods of construction and gives the results of statical and drop tests. Ill. 1400 w. Eng News—Nov. 27, 1902. No. 52031.

Foundations.

See Civil Engineering, Bridges.

Government Buildings.

The Relation of the Architect and Engineer to the Design and Erection of Government Buildings. John Stephen Sewell. From a paper read at the convention of the Am. Inst. of Archts. at Washington. Discusses their relative positions and the need of improving the system of the construction of these works. 2000 w. Eng News—Dec. 18, 1902. No. 52513.

Masonry.

See Civil Engineering, Bridges.

Reinforced Concrete.

See Civil Engineering, Materials.

Roads.

Roads. John Price. Extract from address before the Birmingham students of the Inst. of Civ. Engrs. Considers the various kinds of pavements, the standard of economy, gradients, cost, etc. 1500 w. Quarry—Dec. 1, 1902. No. 52301 A.

Simplon Tunnel.

The Construction of the Simplon Tunnel (Der Bau des Simplon-Tunnels). Paul Möller. A very complete description of the project, its execution down to the present time, and the methods employed in boring and conveying material; with many illustrations. 7500 w. Zeitschr d Ver Deutscher Ing—Nov. 15, 1902. No. 52, 400 D.

Steps.

How to Lay Portland Cement Steps, Curbs, and Similar Structures. F. H. Crafts. Directions, with illustrations of tools used. 1100 w. Munic Eng—Dec., 1902. No. 52085 C.

Wind Pressure.

The Effect of Wind Pressure on Structures. R. M. Neilson. A discussion of the principles upon which the strength of structures exposed to wind should be proportioned, with data from the most recent experiments and authorities. 4500 w. Engineering Magazine—January, 1903. No. 52489 B.

MATERIALS.

Cement.

The Portland Cement Industry (L'Industrie du Ciment Portland). E. Candlot. A general account of the method of making Portland cement with illustrated descriptions of works in various countries. 10,000 w. Bull Soc d'Encour—Nov. 30, 1902. No. 52434 G.

Clay.

An Unrecorded Property of Clay. H. J. Cambie. On the loss of its cohesive properties, if dried sufficiently to remove all its moisture. 1000 w. Can Soc of Civ Engrs—Adv Proof—Dec. 4, 1902. No. 52-288 D.

Researches upon the Plasticity of Clay (Recherches sur la Plasticite des Argiles). B. Zschokke. An exhaustive study of clays, and their uses in the arts. 12000 w.

Bull Soc d'Encour—Nov. 30, 1902. No. 52434 G.

Corrugated Iron.

Practical Applications of Corrugated Iron (Etude sur l'Emploi Pratique des Toles Ondulées). J. E. Delluc. With especial reference to the uses of corrugated iron for roofs and sides of buildings, with details of methods used in France and data of standard French sizes. 1500 w. Revue Technique—Dec. 10, 1902. No. 52431 D.

Plates.

Experiments on Sheet Iron Plates (Expériences sur des Bordages en Tôle). M. Galliot. Data and results of tests on flat and buckled plates of sheet iron under hydraulic pressure, with formulas deduced from the experiments. 3000 w. 1 plate. Ann des Ponts et Chaussées—2 Trimestre, 1902. No. 52450 E+F.

Reinforced Concrete.

Compressive Resistance of Concrete-Steel and Hooped Concrete. A translation of an important paper by M. Considère, in *Le Génie Civil*, and in *Beton und Eisen*, on his recent experiments on concrete-steel in compression, showing the superiority of reinforcing concrete prisms by wire wound helically. Two articles. 6500 w. Eng Rec—Dec. 20, 27, 1902. No. 52570.

Concrete Piles of the Hennebique System. Illustrated abstract of a paper by Leopold Mensch before the Civil Engineers' Club of Cleveland, Ohio, describing solid reinforced concrete piles on the Hennebique system. 600 w. Eng Rec—Dec. 27, 1902. No. 52583.

Loading Tests of Ransome Concrete-Steel Floor Construction. An illustrated account of comparative tests of full-size floor panels, of different spans and construction, made for the Building Department of the Borough of Richmond, New York City. 1200 w. Eng Rec—Dec. 20, 1902. No. 52569.

Monier Concrete-Steel Storage Tanks for Portland Cement; Illinois Steel Co. Brief illustrated description of four bins or tanks constructed in South Chicago, Ill., having a total capacity of 25,000 bbls. 1000 w. Eng News—Dec. 11, 1902. No. 52351.

The Resistance of Reinforced Concrete to Flexure (Résistance et Déformations du Béton Armé Sollicité à la Flexion). F. Schüle. A complete account of exhaustive tests made at the Zurich Polytechnic, using the Amsler testing machine and the Bauschinger mirror apparatus. Three articles. 8000 w. Schweiz Bauzeitung, Nov. 29, Dec. 6, 13, 1902. No. 52461 each B.

The Theory of Structures of Combined Concrete and Iron (Zur Theorie der Verbund Kôrper aus Beton und Eisen). K. Haberkalt. A mathematical discussion of the theory of reinforced concrete structures; with practical applications. Two articles. 7500 w. Oesterr Wochenschr f d Oeffent Baudienst—Nov. 29, Dec. 6, 1902. No. 52484 each D.

MEASUREMENT.

Moment of Inertia.

A New Method of Calculating the Moment of Resistance and the Moment of Inertia (Nouvelle Méthode pour le Calcul du Moment de Résistance et du Moment d'Inertie). M. Lathuillière. Deriving a method especially applicable to built-up beams and girders, materially reducing the labor of computation. 2500 w. Revue Technique—Dec. 10, 1902. No. 52432 D.

Moments of Inertia. R. M. Neilson. The first of series of articles aiming to render the question of moments of inertia clear to those who have been perplexed. 800 w. Prac Engr—Nov. 28, 1902. Serial. 1st part. No. 52253 A.

Surveying.

The Hammer-Fennel Tachymeter-Theodolite (Der Hammer-Fennel'sche Tachymeter-Theodolit). Edouard Dolezal. Describing an improved form of stadia apparatus, with examples showing its accuracy and convenience. 3000 w. Zeitschr Oesterr Ing u Arch Ver—Dec. 5, 1902. No. 52419 B.

See Mining and Metallurgy, Mining.

MUNICIPAL.

Aldershot.

Recent Municipal Works at Aldershot, England. Nelson F. Dennis. Abstract of paper before the Assoc. of Municipal and County Engineers, describing the sewage works, refuse destructor, electric works, etc., of this great military camp. 2000 w. Eng Rec—Dec. 27, 1902. No. 52582.

Explosives.

Proposed Rules to Govern the Storage and Use of Explosives in New York City. Gives the important features of rules formulated by the Municipal Explosives Commission appointed by the Mayor. Also editorial. 4300 w. Eng News—Dec. 18, 1902. No. 52516.

Habana.

Sanitary Condition of Habana. Report tending to show that the healthy conditions brought about by thorough cleansing and inspection system are relaxing and there is a danger of returning to the former unsanitary conditions. 2200 w. U S Cons Repts, No. 1508—Dec. 1, 1902. No. 52082 D.

Pavements.

Pavements Injured by Water. J. W. Howard. Claims that all kinds of pave-

ments are more or less injured and gives a record of experiments to show that the solubility test is needed in all specifications. 2500 w. Munic Jour & Engr—Dec., 1902. No. 52148 C.

What Are Paving, Repaving and Repair? Charles Carroll Brown. A discussion of this question giving legal decisions of several states. 2400 w. Munic Engng—Dec., 1902. No. 52084 C.

Refuse Destructors.

The "Fuel" Value of Town Refuse. Ed. C. de Segundo. An article arguing that refuse destructors must be regarded primarily as sanitary appliances, although, within limits, their heat may be usefully applied. 3500 w. Page's Mag—Dec., 1902. No. 52556 B.

Sewage Purification.

Sewage Purification by Septic Tanks. M. J. McGuigan. Gives an illustrated description of the successful septic tanks at Vancouver, B. C., their construction and operation. 1200 w. Munic Jour & Engr—Dec., 1902. No. 52147 C.

The Mechanical Purification of Sewage (Ueber Anstalten zur Mechanischen Reinigung der Abwasser). Dr. Th. Weyl. Describing especially the installation of the Mairich system at Ohrdruf near Gotha. 2000 w. 1 plate. Gesundheits-Ingenieure —Nov. 15, 1902. No. 52474 B.

The Proper Operation of Sewage Purification Plants. John W. Alvord. Abstract of a paper prepared for the meeting of the Am. Soc. of Munic. Imp. On the proper regulation of Septic tanks, contact beds, etc., with notes on plants built by the author. 3500 w. Eng News—Nov. 27, 1902. No. 52037.

The Stability of Effluents of Sewage Filters of Coarse Materials. H. W. Clark. Slightly condensed from a paper in the 1901 report of the State Board of Health of Massachusetts, giving results of experiments on bacterial action. 3500 w. Eng Rec—Dec. 27, 1902. No. 52580.

Sewers.

Difficult Sewer Construction at Newton, Mass. Brief illustrated description of difficulties met and overcome in the recent extension through Hemlock Gorge, due to the physical features. 600 w. Eng Rec—Nov. 29, 1902. No. 52121.

Suggested Improvement of the Sewer System of Chicago. Extracts from an address by George W. Jackson relating to the present condition and proposed improvements. 1200 w. Eng News—Dec. 11, 1902. No. 52350.

Snow.

The Removal of Snow in New York City. An explanation of the form of contract by which the snow is to be removed this winter, which differs greatly from any previous contract; discusses the advantages of the system. 2000 w. Eng Rec —Dec. 13, 1902. No. 52348.

Street Cleaning.

A Street Sprinkling and Sweeping Machine (Balayeuse-Arroseuse-Ramasseuse). An illustrated description of a machine for sprinkling, sweeping, and collecting refuse at one continuous operation. 1200 w. Génie Civil—Dec. 6, 1902. No. 52425 D.

Subway.

The Aberdeen Cable Subway and Outfall Sewer. G. R. G. Conway. An illustrated description of an electric cable subway which men can walk in, constructed on top of a large sewer. 3500 w. Feilden's Mag—Dec., 1902. No. 52558 B.

Trackway.

An Experimental Steel Trackway in New York City. Describes a steel trackway being laid in Murray St., New York city, which is expected to furnish valuable and interesting information regarding steel trackways in city streets. 800 w. Eng News—Dec. 4, 1902. No. 52167.

Rail Tracks for Highway Traffic. Abstract of a paper by Herr A. Nessenius, translated from the *Organ für die Fortschritte des Eisenbahnwesens*. A study of the efforts and experiences of German engineers in the construction of an economical and serviceable iron track for highway purposes. 3000 w. Eng Rec—Dec. 13, 1902. No. 52347.

WATER SUPPLY.

Aqueduct.

The Aqueduct of the Avre (L'Aqueduc de l'Avre). M. Bret. A description of the completed reservoir of Saint Cloud and the aqueduct which brings the water of the Avre and the Vigne to Paris. 10,000 w. 2 plates. Ann des Ponts et Chausées —2 Trimestre, 1902. No. 52448 E+F.

Artesian Supply.

The Artesian Water Supply of Memphis, Tenn. Describes the present supply derived from the water-bearing sand underlying the Mississippi Valley about 350 ft. below the surface, with interesting matter from two recent reports. 3200 w. Eng Rec—Nov. 29, 1902. No. 52120.

Butte, Montana.

The New Works and Water Supply of the Butte Water Company. Charles W. Paine. Illustrated description of new works consisting of a pipe line 27.2 miles in length, three reservoirs, and two pumping stations. 4300 w. Jour Assn of Engng Socs—Oct., 1902. No. 52275 C.

High-Pressure Plant.

High Pressure Pumping Plant and Force Main for the Water-Works of Pres-

We supply copies of these articles. See page 817.

cott, Ariz. W. W. Follett. An illustrated description of a pumping plant and pipe line for 500,000 gallons per day. 2800 w. Eng News—Dec. 18, 1902. No. 52511.

Irrigation.

An Hawaiian Sugar Plantation. Charles W. Goodale. Describes extensive irrigating operations. 1800 w. Jour Assn of Engng Socs—Oct., 1902. No. 52276 C.

London.

The New Augmented Water Supply and Reservoirs for London. A fully illustrated article describing these works. 1500 w. Sci Am Sup—Dec. 13, 1902. No. 52328.

Ozone.

The Siemens Ozone Purifying Plants at Wiesbaden, Schierstein and Paderborn (Siemenssche Ozonwasserwerke, Wiesbaden-Schierstein und Paderborn). Dr. G. Erlwein. Detailed illustrations of these extensive plants, sterilizing 250 cubic metres of water per hour by means of ozone. 2000 w. Zeitschr f Elektrochemie—Nov. 27, 1902. No. 52473 G.

Paris.

The Water Supply of Paris (L'Alimentation de Paris en Eau). M. Bret. A review of the present supply with maps showing the distribution. 3500 w. 1 plate. Ann des Ponts et Chaussées—2 Trimestre, 1902. No. 52451 E+F.

Pipe Corrosion.

See Street and Electric Railways, Stray Currents.

River Pollution.

Pollution and Self-Purification of the River Severn at Shrewsbury. A review by George C. Whipple of a report issued by the Royal Commission on Sewage Disposal. 1500 w. Eng Rec—Nov. 29, 1902. No. 52118.

Stand-pipe.

A Wrecked Wooden Water Tank and a New Steel Stand-pipe at Madison, Neb. Arnold C. Koenig. An account of a failure of an elevated water tank and details of construction of a new stand-pipe. 900 w. Eng News—Dec. 18, 1902. No. 52514.

Submerged Mains.

Submerged Steel Pipes for the Jersey City Water-Works. An illustrated description of the pipes and methods of laying. 2800 w. Eng Rec—Dec. 13, 1902. No. 52346.

Water Softener.

Water-Softener of the Maschinenfabrik Grevenbroich. Illustrated description of an apparatus exhibited at Düsseldorf, which is popular in Germany and employed in many large works. 1400 w. Engng—Nov. 21, 1902. No. 52072 A.

ELECTRICAL ENGINEERING

COMMUNICATION.

Automatic Exchange.

The Automatic Telephone Exchange. Joseph B. Baker. Some facts relating to the service rendered and the advantages of this system. 1700 w. Elec Rev, N Y—Dec. 13, 1902. No. 52331.

Cables.

Imperial Telegraphic Communication. Charles Bright. An address before the London Chamber of Commerce on the British Pacific cable in particular, and on the submarine cable system of the British Empire in general. Serial. Part I. 3500 w. Elec Rev, Lond—Dec. 12, 1902. No. 52547 A.

Telephone Cables. Arthur V. Abbott. This first article discusses the principles of circuit design. Ill. 3700 w. Elec Wld & Engr—Dec. 6, 1902. Serial. 1st part. No. 52263.

The Vera Cruz-Frontera-Campechi Cable for the Mexican Government. Illustrates and describes the making and laying of this cable. 3000 w. Elec Rev, N Y—Dec. 13, 1902. No. 52333.

Cable Testing.

See Electrical Engineering, Measurement.

Coherer.

The Castelli Coherer. An illustrated review and history of this coherer, in which one or more drops of mercury are placed between iron or carbon electrodes. 1500 w. Elec Rev, Lond—Dec. 12, 1902. No. 52543 A.

Exchanges.

Memphis Telephone Company's Exchange System. Illustrated description. 1500 w. Elec Rev, N Y—Dec. 6, 1902. No. 52215.

The Latest Telephone Exchange on Manhattan Island. Illustrated description of the "Morningside" exchange in upper New York. 700 w. Elec Wld & Engr—Dec. 6, 1902. No. 52264.

The New Telephone Exchanges of the Post Office. Illustrated description of two new exchanges of the London Post Office telephone service which have been opened recently on the common battery system. 1000 w. Elect'n, Lond—Nov. 21, 1902. No. 52063 A.

We supply copies of these articles. See page 817.

Independent Telephony.

Greater Permanent Progress of the Independent Telephone Industry. Fred De Land. Comments on cheap rates and the cost of maintenance. 2700 w. Elec Rev, N Y—Dec. 6, 1902. No. 52213.

Independent Telephony in Buffalo. James Malcolm. Illustrated description of the plant under construction and the system. 1500 w. Elec Wld & Engr—Dec. 13, 1902. No. 52502.

Lightning.

Improved Lightning Protection for Telephone Lines (Ueber Neue Blitzschutzeinrichtungen für Fernsprechleitungen). Dr. Adolf Franke. Describing an improved form of lightning arrester with carbon points in vacuum. 4000 w. Elektrotech Zeitschr—Nov. 27, 1902. No. 52465 B.

Light Telephony.

Ruhmer's Photoelectric Telephone. A. Frederick Collins. An illustrated article giving an account of Ernst Ruhmer's experiments on the Wannsee, near Berlin, in which a beam of light from an electric arc in a parabolic reflector was sent 7 kilometers to a selenium cell in another reflector. 2000 w. Elec Wld & Engr—Dec. 20, 1902. No. 52519.

Pupin System.

Experiments on the Application of Pupin's System to Telephone Circuits. F. Dolezalek and A. Ebeling. An illustrated article translated from the *Elektrotechnische Zeitschrift*, giving an account of experiments carried out by the Siemens & Halske Co. in Germany, on underground cables and overhead telephone lines with Pupin induction coils. Serial. Part I. 2000 w. Elec Rev, Lond—Dec. 12, 1902. No. 52544 A.

Experiments upon the Pupin Long-Distance Telephone System (Untersuchungen über Telephonische Fernleitungen Pupinschen Systems). F. Dolezalek and A. Ebeling. A full account of the tests of the Pupin system made to determine its commercial value for the firm of Siemens & Halske. 5000 w. Elektrotech Zeitschr—Dec. 4, 1902. No. 52468 B.

Space Telegraphy.

Wireless Telegraphy in France. E. Guarini. An illustrated review of the work in this field. 1200 w. Elec Rev, Lond—Nov. 28, 1902. Serial. 1st part. No. 52183 A.

Space Telephony.

Wireless Telephony by the Collins System. A. Frederick Collins. Reviews work in this field and gives an illustrated description of the writer's system, and an account of what he has accomplished. 2500 w. Elec Rev, N Y—Nov. 29, 1902. No. 52107.

Telephone Call.

Telephone Call Operating by Reversal of Current (Rappel Téléphonique par Inversion de Courant). L. Martin. Describing a system in which any one of three telephones on a circuit may call one of the others without affecting the third. 1200 w. Revue Technique—Nov. 25, 1902. No. 52429 D.

Telephone Rates.

The Sliding Scale of Rates for the Telephone Company. Henry S. Herr. A paper before the Interstate Independent Telephone Association, showing the necessity for increasing rates as the number of subscribers connected to an exchange increases. 1600 w. Elec Rev, N Y—Dec. 20, 1902. No. 52525.

Telephony.

Telephone Situation in the Twin Cities. Huntley L. Howard. An illustrated article giving the history of the telephone business in Minneapolis and St. Paul, describing the plant. 5800 w. Telephony—Dec., 1902. No. 52216.

The Telephone Situation of To-day. A. E. Dobbs. Statistics showing the rapid growth of the independent telephone business, and the lessons learned. 2300 w. Elec Rev, N Y—Dec. 13, 1902. No. 52330.

Transmitter.

The Pasquet Telephone Transmitter (Transmetteurs Téléphoniques, Système Louis Pasquet). J. A. Montpellier. Describing the improved form of microphone transmitter used in the French government lines. 1500 w. L'Electricien—Nov. 22, 1902. No. 52478 B.

The Telephone Transmitter, Its Early History, Its Present Status with Relation to the Berliner Patent—Past and Present. J. J. Nate. Abstract of paper before the Interstate Independent Telephone Association, giving a history of telephone invention. 1200 w. Elec Rev, N Y—Dec. 20, 1902. No. 52526.

DISTRIBUTION.

Accumulators.

See Electrical Engineering, Electro-Chemistry.

Converters.

Experiments on Synchronous Converters. W. M. Thornton. Read before the Newcastle Local Section of the Inst. of Elec. Engrs. The object of the experiments was to find how the efficiency varied with load for all conditions of excitation; to find any discrepancies between the theoretical and observed losses; and to locate the causes which would give rise to them.

We supply copies of these articles. See page 817.

4200 w. Elec Engr, Lond—Dec. 5, 1902. No. 52380 A.

Fuses.

The Permanency of Safety Fuses (Ueber Unwerwechselbarkeit bei Schmelzsicherungen). R. Hundhausen. A review of various forms of fuse construction, with data concerning their permanency. 5000 w. Elektrotech Zeitschr—Dec. 4, 1902. No. 52469 B.

Karlsruhe.

The Light and Power Plant of the Port of Karlsruhe on the Rhine (Die Licht und Kraftanlagen des Rheinhafens zu Karlsruhe). F. Winawer & C. Bender. A detailed account of the transformer station and electric distribution; also electric cranes, hoists, and conveyers; together with lighting plant. The current is obtained from the municipal plant. 3000 w. Zeitschr d Ver Deutscher Ing—Nov. 29, 1902. No. 52406 D.

Sub-Stations.

The Electrical Equipment of Sub-Stations. E. Parry and W. Casson. An illustrated description of the arrangements and apparatus in sub-stations of electric distribution systems, as designed by H. F. Parshall, with plans and diagrams. 6500 w. Trac and Trans—Dec., 1902. No. 52-561 E.

Subway.

See Civil Engineering, Municipal.

Transformation.

Six-Phase Transformation. A. S. McAllister. Explains the transformation from two or three phases to six phases by means of rotary converters. Diagrams. 900 w. Am Elect'n—Dec., 1902. No. 52-247.

ELECTRO-CHEMISTRY.

Accumulators.

How to Determine the Best Conditions in Storage Battery Practice. Carl Hering. A discussion of the most economical commercial operation of accumulators, considering both first cost and operating expenses. 3000 w. Elec-Chem Ind—Dec., 1902. No. 52588 C.

The Storage Battery as an Electrolytic Cell. C. J. Reed. A general review of the principles of electrolytic action and the relation between storage batteries and other electrolytic cells. 3500 w. Elec-Chem Ind—Dec., 1902. No. 52590 C.

Ampere Company.

The Ampere Electro-Chemical Company. An account of an experimental company, with a laboratory at Niagara Falls, whose object is to originate and develop new electro-chemical processes to the point of commercial application. 900 w. Ir Age—Dec. 18 ,1902. No. 52535.

Calcium and Strontium.

The Production of Calcium and Strontium. H. Danneel. An illustrated description of an electric furnace and process used at the Institute for electro-metallurgy at Aachen, Germany, by which pure calcium and strontium are obtained from their chlorides. 1000 w. Elec Wld & Engr—Dec. 20, 1902. No. 52523.

Calcium Carbide.

Calcium Carbide and Acetylene. A general review of these industries, with illustration and curves. 1400 w. Elec-Chem Ind—Dec., 1902. No. 52589 C.

Copper.

Electrolytic Refining of Copper. An illustrated description of the method, translated from *La Nature*. 1200 w. Sci Am Sup—Dec. 6, 1902. No. 52221.

Electric Furnaces.

High Temperature Electro-chemistry. R. S. Hutton and J. E. Petavel. Abstract of a paper before the Manchester Local Section of the Institution of Electrical Engineers, illustrating and describing experimental and technical electrical furnaces, particularly those in the electrochemical laboratory of Owens College. Manchester, Eng. Serial. Part I. 1500 w. Elect'n, Lond—Dec. 12, 1902. No. 52531 A.

Recent Electrochemical Developments. Clinton Paul Townsend. An illustrated description of electric furnace structures, of the "tube" type, invented by H. N. Potter. 800 w. Elec Wld & Engr—Dec. 20, 1902. No. 52524.

Electrodes.

Bipolar Electrodes (sur les Electrodes Bipolaires). MM. Brochet & Barillet. A discussion of the effect of a metallic mass placed in an electrolyte and not connected with either electrode. 1500 w. Comptes Rendus—Nov. 17, 1902. No. 52440 D.

Electrolysis.

General Characteristics of Electrolysis. Harry S. Coyle. Discusses mainly its usefulness in the sciences and arts and its laws. 2200 w. Telephony—Dec., 1902. No. 52217.

Lithography.

Electrochemistry in Lithography. E. C. Handy. A brief account of a new process which greatly reduces the cost of this class of work. 900 w. Elec Wld & Engr—Dec. 13, 1902. No. 52504.

Nickel Cell.

Self-Forming Separator in a Nickel Peroxide Storage Cell. A. L. Marsh. Describes the construction of this cell, which is said to have considerable advantage over the dry cells in present use. 900 w. Elec Wld & Engr—Dec. 13, 1902. No. 52-503.

We supply copies of these articles. See page 817.

Ozone.

See Civil Engineering, Water Supply.

Polarization.

Electrochemical Oscillations. Woolsey McA. Johnson. An account of some interesting observations on what may be termed electrolytic memory. 800 w. Elec Wld & Engr—Dec. 13, 1902. No. 52505.

Sodium Chloride.

Sodium Chloride in Electrolytic Caustic Alkali. Clinton Paul Townsend. A paper considering the movement of undecomposed sodium chloride into the caustic compartment of an electrolytic cell, with curves. 1800 w. Elec-Chem Ind—Dec., 1902. No. 52587 C.

Steel.

Manufacture of Steel by the Electric Furnace. Translation, with additions by P. McN. Binnie, of a paper by Charles Bertolus, of St. Etienne, France. Describes the operation of the Keller process at Kerrousse, near Hennebont, giving cost and quality obtained. 4800 w. Ir Age—Dec. 11, 1902. No. 52259.

ELECTRO-PHYSICS.

Electron Theory.

On Electrons. Sir Oliver Lodge. Paper before the Institution of Electrical Engineers, giving full account of the latest theory of electricity and magnetism. Also editorial comment. Serial. Part I. 4000 w. Elect'n, Lond—Dec. 12, 1902. No. 52532 A.

On Electrons. Abstract of an address by Sir Oliver Lodge, explaining the present state of knowledge of electrical theories. 5300 w. Engng—Dec. 5, 1902. No. 52365 A.

Laboratory.

The Electrotechnical Laboratory of the Municipal Electric Works of Munich (Das Elektrotechnische Laboratorium der Städtischen Elektricitätswerke in München). F. Uppenborn. With plan of the building and views of the various rooms and apparatus. 3500 w. Elektrotech Zeitschr—Nov. 27, 1902. No. 52463 B.

Magnetism.

A Theory of Magnetism. Johannes Zacharias. An attempt to prove that the magnetic force is a phenomenon due to pressure. 1800 w. Elec Wld & Engr—Dec. 20, 1902. No. 52522.

Photo-Electric Effects.

Photo-Electric Experiments. A. Frederick Collins. Illustrated description of experiments in photo-electric action. 1700 w. Sci Am Sup—Dec. 20, 1902. No. 52398.

Radiography.

The Determination of the Velocity of X Rays (Observations et Expériences Complémentaires Relatives à la Determination de la Vitesse des Rayons X). R. Blondlot. A continuation of the author's experiments upon the velocity of X rays, together with a discussion of their nature. 1200 w. Comptes Rendus—Nov. 10, 1902. No. 52437 D.

Velocity of Propagation of X-Rays. R. Blondlot. Translated from the *Comptes Rendus*. An account of researches and experiments giving results. 2500 w. Elect'n, Lond—Nov. 21, 1902. No. 52065 A.

GENERATING STATIONS.

Accumulators.

See Electrical Engineering, Electrochemistry.

Chicago, Edison.

The Randolph Street Sub-station and the Development of the Chicago Edison System. A description of some recent features introduced showing important changes that are taking place in the character of this company's distribution. 3800 w. Elec Wld & Engr—Nov. 29, 1902. No. 52109.

Cleckheaton.

Cleckheaton Electricity Works. An illustrated description of a combined electric generating station and refuse destructor in Yorkshire. 1600 w. Elec Rev, Lond—Dec. 12, 1902. No. 52546 A.

Cleckheaton Electricity Works. Illustrated detailed description of works for the supply of light and power, and a refuse destructor from which it is hoped to get much of the steam required. 1800 w. Elec Engr, Lond—Nov. 28, 1902. No. 52178 A.

Commutation.

Commutation. H. St. Hill Mawdsley. Briefly considers methods for improving commutation. Ill. 1000 w. Elec Rev, Lond—Dec. 5, 1902. No. 52382 A.

Converters.

See Electrical Engineering, Distribution.

Dynamos.

The Care of Dynamos and Motors. F. J. A. Matthews. Discusses the care needed, points requiring special attention, etc. 3000 w. Mech Engr—Nov. 22, 1902. No. 52061 A.

The Computations for Continuous-Current Dynamos (Zur Berechnung der Gleichstrommaschine). Emil Korrodi. Discussing a method of determining graphically the proportions of the various parts and arranging them in tabulated form for a series of sizes. 1800 w. Elektrotech Zeitschr—Nov. 27, 1902. No. 52464 B.

The Use of Specific Forms in Designing Dynamo Machinery, and the Design of a Rotary Converter. H. M. Hobart. De-

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scribes a series of forms prepared for use in designing continuous-current commutating machinery. 800 w. Elec Rev, Lond—Dec. 5, 1902. Serial. 1st part. No. 52381 A.

Gas Engines.

See Mechanical Engineering, Special Motors.

Generating Sets.

A Modern Slow-Speed Steam Alternator. An illustrated account of a standard steam-generator of a London firm, which has recently been set to work, with a statement of the performance. 1400 w. Ir & Coal Trds Rev—Dec. 5, 1902. No. 52360 A.

On the Governing of Engines for Alternating Current-Supply. G. R. J. Parkinson. Remarks applying more particularly to the method of connecting alternators directly to a medium-speed engine. 1000 w. Elec Rev, Lond—Dec. 5, 1902. No. 52383 A.

The Wheel Capacity for Engine-Driven Alternators. H. F. Schmidt. Discusses the steam engine side of the question and certain electrical requirements, with a suggestion. 1500 w. St Ry Jour—Dec. 13, 1902. No. 52309 D.

Hydro-Electric Plants.

A Water-Power Plant with a Head of 3,116 ft. at Vouvry, Switzerland. From *Le Genie Civil.* Illustrated description of a plant that will supply electricity for lighting and power to a large number of Swiss towns and villages in the valley of the Rhone. 1000 w. Eng News—Nov. 27, 1902. No. 52028.

The Hydraulic Power Station at Champ (Usine Hydro-Electrique de Champ, Isère). A. Dumas. An illustrated account of the electric station at Champ on the River Drac, near Grenoble, for the development of 7,200 horse power and its electrical distribution. 3000 w. 1 plate. Génie Civil—Nov. 22, 1902. No. 52424 D.

The New Plant of the Canadian Niagara Falls Company. Orrin E. Dunlap. An illustrated report of the progress of the work of the Canadian Niagara Power Co. 1100 w. Sci Am—Dec. 6, 1902. No. 52218.

The Vouvry Water-Power Development of 3,117 Foot Head. From *Le Genie Civil.* An illustrated description of a plant which possesses the highest head of all water power developments yet attempted. 2000 w. Eng Rec—Nov. 29, 1902. No. 52122.

Transmission Plant of the Otonabee Power Company. An illustrated description of a recent Canadian installation. 1900 w. Can Elec News—Dec., 1902. No. 52298.

Water-Power in Electrical Supply. Alton D. Adams. A discussion of several hydro-electric plants in actual operation, with a record of variations in water supply and energy output, showing, on the whole, an economy in the use of water-power. Curves. 2800 w. Cassier's Mag—Dec., 1902. No. 52550 B.

Isolated Plants.

Economy in Design and Operation of Isolated Electric Plants. P. R. Moses. A discussion of the use of auxiliary apparatus in isolated plants, showing the resulting reductions in working costs. 3000 w. Engineering Magazine—January, 1903. No. 52490 B.

Municipal Plants.

Equipment and Operation of Municipal Electric Light Plants in Massachusetts. Alton D. Adams. Notes the progress since the first municipal plant in 1889. 1000 w. Munic Engng—Dec., 1902. No. 52086 C.

Nuneaton.

Nuneaton Electricity Works. An illustrated account of the electric station and distribution system at Nuneaton, Warwickshire, and curves of costs and accounts. 2500 w. Elec Engr, Lond—Dec. 12, 1902. No. 52533 A.

Parallel Driving.

The Parallel Driving of Alternators. (Ueber den Parallelbetrieb von Wechselstrommaschinen). H. Görges. A review of the previous paper of Rosenberg, discussing the synchronizing action of two alternators coupled in parallel. 2500 w. Elektrotech Zeitschr—Dec. 4, 1902. No. 52466 B.

Power House.

See Street and Electric Railways.

Reconstruction.

The Economy of Reconstructing Central Stations to Modern Methods. C. R. Maunsell. Outlines an old and a modern plant showing the gain on investment by modern methods. 1500 w. Am Gas Lgt Jour—Dec. 15, 1902. No. 52390.

Sub-Stations.

See Electrical Engineering, Distribution.

Standards.

Standards for Electrical Machinery and Transformers (Normalien für Elektrische Maschinen und Transformatoren). A revision of the standards of the *Verband Deutscher Elektrotechniker* as set forth in 1901, and discussed at the recent convention at Düsseldorf in June, 1902. 4000 w. Zeitschr d Ver Deutscher Ing—Dec. 13, 1902. No. 52414 D.

Superintendents.

The Qualifications of a Central Station Superintendent. Considers the desirable characteristics as a man and the professional attainments he should possess. 3900 w. Cent Sta—Dec., 1902. No. 52237.

We supply copies of these articles. See page 817.

LIGHTING.

Illumination.

Display Lighting. Signs and Decorations. Russell Spaulding. Suggestions helpful in producing good effects in this work. 1600 w. Cent Sta—Dec., 1902. No. 52236.

Distributed Lighting. Douglass Burnett. On means for measuring the illumination of surfaces. A study of the distribution and diffusion of light. 2000 w. Trans Am Inst of Elec Engrs—Nov., 1902. No. 52291 D.

Some Notes on Illumination. Bassett Jones, Jr. An article discussing various methods of lighting required under certain specific conditions. 1500 w. Elec Wld & Engr—Dec. 20, 1902. No. 52520.

Photometry.

Discussion of Papers on Photometry and Illumination. 11300 w. Trans Am Inst of Elec Engrs—Nov., 1902. No. 52-294 D.

Integrating Photometer for Glow Lamps and Sources of Like Intensity. Charles P. Matthews. Illustrates and describes an apparatus for the photometric study of incandescent lamps and other sources of the same order of brightness. 3300 w. Trans Am Inst of Elec Engrs—Nov., 1902. No. 52290 D.

Some Methods of Photometry as Applied to Incandescent Lamps. J. T. Marshall. Describes the invention and use of the sliding scale photometer. 1800 w. Trans Am Inst of Elec Engrs—Nov, 1902. No. 52292 D.

The Commercial Accuracy of Photometrical Measurements. Clayton H. Sharp. Discusses whether photometrical measurements conform in general to the requirements of commercial accuracy. 2500 w. Trans Am Inst of Elec Engrs—Nov., 1902. No. 52293 D.

Train Lighting.

A French System of Train Lighting. P. Letheule. A description, with diagrams of the M. F. Loppe system of electric lighting for trains, in which the dynamo has two field windings in opposition, so that the voltage is regulated closely. A storage battery is also used. 2000 w. Elec Wld & Engr—Dec. 20, 1902. No. 52521.

MEASUREMENT.

Cable Testing.

Plant for Testing Cables at High Pressures. Stuart A. Russell. A description of a plant installed by the India Rubber, Gutta Percha and Telegraph Works Co. of Silvertown, Eng., for testing submarine cable core at a pressure of 5000 volts. Diagrams. 1200 w. Engr, Lond (Elec Engng Sup)—Dec. 12, 1902. No. 52542 A.

Efficiency.

A Method of Determining the Efficiency of Dynamos. J. R. Ashworth. On the use of retardation curves for efficiency determinations. 2000 w. Elec Rev, Lond—Nov. 28, 1902. No. 52179 A.

Graduations.

The Graduations of Electrical Measuring Apparatus (Sulla Graduazione degli Apparecchi Elettrici di Misura). V. Arcioni. Discussing graphical methods for laying out the scales of instrumental graduations so as to insure approximate uniformity. 1200 w. L'Elettricita—Nov. 30, 1902. No. 52482 B.

Indicator.

A Recording Indicator for Maximum Currents and Shortcircuits (Ein Registrirender Maximalstrom und Kurzschlussanzeiger). H. Marken. A solenoid opposed by a spring is connected with a recording mechanism and revolving disc. 1800 w. Elektrotech Zeitschr—Dec. 11, 1902. No. 52472 B.

Insulation.

The Measurement of Defects in Insulation in Multiple Conductors (Die Messung von Isolationsfehlern bei Mehrleiteranlagen). E. Müllendorff. Deriving equations by use of which the leakage may be determined according to its distribution from successive measurements. 1200 w. Elektrotech Zeitschr—Dec. 11, 1902. No. 52471 B.

Meter Testing.

Testing Electric Meters in Place (Verification sur Place des Compteurs d'Energie Electrique). M. Aliamet. Giving methods of testing the Aron meter, with practical examples. Three articles, 3500 w. L'Electricien—Nov. 29, Dec. 6, 13, 1902. No. 52479 each B.

Photometry.

See Electrical Engineering, Lighting.

Thermal Instruments.

The Olivette Thermal Instruments (Appareils Thermiques de la Maison Olivette). A. Bainville. Describing voltmeters and ampere meters which operate by the heating and expansion of platinum wire. 1000 w. L'Electricien—Nov. 29, 1902. No. 52480 B.

Three-Phase.

The Measurement of Three Phase Currents by a Single Wattmeter (Mesure à l'Aide d'un Seul Wattmètre de la Puissance dan les Circuits Equilibrés, parcourus par des Courants Triphases). O. Robert. The method involves the connection of the two wires of the instrument successively with the three circuit wires. 1200 w. Revue Technique—Dec. 10, 1902. No. 52433 D.

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Three-Phase Measurements. A. S. McAllister. Analyzes a case of current unbalance in a three-phase system, showing how inaccurate may be the results of formulae which apply to wattmeter measurements when dealing with balanced circuit. 1200 w. Elec Wld & Engr—Dec. 13, 1902. No. 52506.

POWER APPLICATIONS.

Differential Compounding.

The Differentially-Compounded Motor. W. R. Kelsey. A discussion of the design of differential-compound field windings for electric motors where close speed regulation is necessary; with curves. 1000 w. Elec Engr, Lond—Dec. 12, 1902. No. 52534 A.

Machine Tools.

Electric Power Required by Various Tools and General Construction Methods Abroad. Notes some of the methods of construction, data of power used, and general equipment of foreign plants having modern equipments, and the methods of control of the alternating-current motors. 3500 w. Mod Mach—Dec., 1902. No. 52140.

Mining.

Electric Power for General Purposes in Mining and Milling. John B. Tregloan. Read before the California Miners' Assn. Deals with results obtained in Amador Co., Cal., using electricity at $6.50 per h. p. per month. 2800 w. Min & Sci Pr—Nov. 29, 1902. No. 52210.

The Use of Electricity in Modern Mining Installations. Frank C. Perkins. Information regarding modern electric installations, both of direct and alternating current. Ill. 1400 w. Min Rept—Nov. 27, 1902. Serial. 1st part. No. 52099.

Railway Shops.

Electricity in Railroad Shops. L. R. Pomeroy. A discussion of the power question and the advantages of the electric drive, the losses, etc., with suggestions. General discussion follows. 8500 w. Cent Ry Club—Nov., 1902. No. 52336 C.

Speed Control.

A Variable Reluctance Method of Motor Speed Control. G. Frederick Packard. Describes the special construction patented by Frederick A. Johnson for providing speed control over a very wide range in motors. Discusses also the regulators patented by Thomas A. Edison and by Philip Diehl. Ill. 3500 w. Trans Am Inst of Elec Engrs—Nov., 1902. No. 52295 D.

Oerlikon Polyphase Motor with Four Speeds (Drehstrommotor der Maschinen fabrik Oerlikon mit Vier Geschwindigkeitsstufen). Dr. H. Behn-Eschenburg. A description of an improved polyphase for speeds of 500, 750, 1,000 and 1,500 revolutions per minute; also of a continuous-current motor for 350 to 1,600 revolutions. 3500 w. Elektrotech Zeitschr—Dec. 4, 1902. No. 52467 B.

The Speed Regulation of Induction Motors (Die Tourenregulirung von Induktionsmotoren). M. Osnos. An examination of the efficiency at various speeds for different styles of induction motors. 6000 w. Elektrotech Zeitschr—Dec. 11, 1902. No. 52470 B.

Three-Phase Motors with Wide Range of Speed Variation. Dr. H. Behn-Eschenburg. Illustrates and describes the new drum windings introduced by the Oerlikon Co., stating the advantages gained. 2800 w. Elect'n, Lond—Nov. 21, 1902. No. 52064 A.

Steel Works.

Electrically Operated Charging Machines, Hoists, Hauling and Conveying Apparatus in Iron and Steel Works. Frank C. Perkins. Illustrated description of various forms of apparatus in which electric motive power is employed. 3300 w. Sci Am Sup—Dec. 20, 1902. No. 52396.

Steering Gear.

See Marine Engineering.

TRANSMISSION.

California.

The Northern California Power Company's Transmission. An illustrated detailed description of the system of this company for furnishing light and power. 3800 w. Jour of Elec—Dec., 1902. No. 52274 C.

Switzerland.

A European 30,000-Volt Three-Phase Power Transmission. Illustrated description of the high-tension plant between Hochfelden and Oerlikon. 2500 w. Elect'n, Lond—Dec. 5, 1902. No. 52384 A.

See also Electrical Engineering, Generating Station.

MISCELLANY.

Address.

Some Limits in Heavy Electrical Engineering. James Swinburne. Presidential address to the Inst. of Elec. Engrs., London. Confined to a discussion of heavy electrical engineering. 4000 w. Elect'n, Lond—Dec. 5, 1902. Serial. 1st part. No. 52385 A.

Development.

A Study of Electrical Developments. Valentine Ryan. The present article is a review of the general conditions of the electrical industry, calling attention to some things yet to be accomplished. 2200 w. Elec Rev, Lond—Nov. 21, 1902. Serial. 1st part. No. 52066 A.

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GAS WORKS ENGINEERING

Calcium Carbide.

See Electrical Engineering, Electrochemistry.

Coal Storing.

Coal-Storing Plant at the Ipswich Gas-Works. An illustrated description of a complete and somewhat unique plant, comprising the unloading, weighing and conveyance to the coal stores. 1200 w. Jour Gas Lgt—Dec. 2, 1902. No. 52376 A.

Conveying.

Coal Unloading and Conveying Plant at the Nancy Gas Works. An illustrated description, from the *Journal für Gasbeleuchtung* of the arrangements at this town in France. 800 w. Jour Gas Lgt—Nov. 18, 1902. No. 52057 A.

Distribution.

Distribution Practice in the United States. Describes as well as possible what is considered good distribution practice in the gas industry. Ill. 6000 w. Jour Gas Lgt—Nov. 25, 1902. No. 52173 A.

Efficiency.

Efficiency in Gas Manufacture. S. Tagg. Read before the Manchester and District Jour. Gas Assn. A discussion of methods best adapted to secure economy in gas making and the principles that should guide gas engineers. 5600 w. Jour Gas Lgt—Dec. 2, 1902. No. 52377 A.

Explosions.

Experiments on Gas Explosions in a Closed Vessel. L. Bairstow and E. C. Horsley. An account of experimental investigations with results. 900 w. Engng—Nov. 28, 1902. No. 52192 A.

Gas Engines.

See Mech. Engineering, Special Motors.

Mantles.

Microscopical Examination of Incandescent Mantles. Dr. C. Killing. Translated from the *Jour für Gasbeleuchtung*. An illustrated account of investigations. 2300 w. Pro Age—Dec. 15, 1902. No. 52340.

Mond Gas.

Mond Gas Plant at Farnley. Illustrates and describes the plant of the Farnley Iron Co., Ltd., near Leeds, which will produce gas equivalent to 20,000 h. p., were it all to be used in engines. 2000 w. Nov. 21, 1902. No. 52079 A.

Natural Gas.

Natural Gas in Sussex. A brief account of the discovery of gas at Heathfield, England, the composition and geological formation, and what has been done to test the extent of the field. 1300 w. Gas Wld—Nov. 22, 1902. No. 52054A.

New Works.

A Complete New Gas Works for Slough. An illustrated description of an inclined retort system for small works, with explanatory notes. 3500 w. Jour Gas Lgt—Nov. 18, 1902. No. 52056 A.

Photometry.

See Electrical Engineering, Lighting.

Pipe Corrosion.

See Street and Electric Railways, Stray Currents.

Tar.

Determination of Water in Tar. Herr Becker. Illustrates and describes an apparatus which gives an exact and rapid analysis. 800 w. Gas Wld—Nov. 22, 1902. No. 52055 A.

INDUSTRIAL ECONOMY

Accounting.

Property Returns on Public Works. A. F. Bridgman. An outline of methods adopted by the U. S. and State governments and various commissions in charge of public works, for taking account of stock and making inventories of property. 1200 w. Eng Rec—Dec. 27, 1902. No. 52577.

Address.

Sir William Henry Preece's Address before the Society of Arts. Discusses manufactures and commerce aiming to determine the causes which result in successful or disastrous financial undertakings and showing that the commercial conduct of industrial processes follow distinct laws. 7700 w. Jour Soc of Arts—Nov. 21, 1902. No. 52051 A.

The Science of Business. Editorial review of Sir William Henry Preece's address before the Society of Arts. 1800 w. Engng—Nov. 21, 1902. No. 52074 A.

Cost Keeping.

Cost Finding for Moderate-Sized Shops. Hugo Diemer. An example of the suc-

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cessful application of the premium system to a shop employing about 400 men in the manufacture of machine tools. 2500 w. Engineering Magazine—January, 1903. No. 52491 B.

Decadence.

Decadent Industrial Works. Discusses the subject in relation to individual concerns, and the causes. 1200 w. Ir Age—Dec. 4, 1902. No. 52132.

Education.

The Springfield (Mass.) Evening School of Trades. E. R. Markham. An illustrated description of the school and an account of the work done. 2500 w. Am Mach—Dec. 4, 1902. No. 52162.

The Training of Professional Engineers. Prof. John Goodman. A practical discussion of engineering education in both shop and college. 2000 w. Page's Mag—Dec., 1902. No. 52554 B.

Engineering Co-operation.

The Engineer of the Twentieth Century. Chas. F. Scott. Address before the Engineers' Club of Philadelphia, urging the closer co-operation of the American engineering societies and the erection of an engineering societies' building in New York. 1200 w. Elec Rev, N Y—Dec. 20, 1902. No. 52528.

Eng'neering Economics.

The Engineer as Financier. Dr. Robert H. Thurston. An able review of the financial and economic problems which the engineer is called upon to solve, and of increasing importance in the organization and advancement of civilization and his vast opportunities. 7500 w. Cassier's Mag—Dec., 1902. No. 52551 B.

Insurance.

Insurance of Ships at Lloyds. Lawrence Irwell. Brief account of Lloyd's coffee house and other matters bearing upon the insurance of ships. 3200 w. Marine Rev—Dec. 11, 1902. No. 52302.

Invention Development.

The Commercial Development of Inventions. James Swinburne. A very entertaining account of the difficulties that beset the average inventor, and a suggestion for a strong financial concern that will develop inventions on terms fair to all parties. 4800 w. Page's Mag—Dec., 1902. No. 52553 B.

Krupp.

Notes on the Krupp Works (Eniges über Krupp). A brief review of the development of the Krupp works, with plate of illustrations showing views in the works and plans and elevations of the workmen's houses. 1200 w. Oesterr Zeitschr f Berg u Hüttenwesen—Nov. 29, 1902. No. 52459 D.

Output.

Limitation of Output by Molders. James A. Murphy. Discusses the restriction of output, and the attitude of the Molders' Union. 1700 w. Ir Trd Rev—Dec. 4, 1902. No. 52157.

Patents.

The International Union for the Protection of Industrial Property and the German Empire (Die Internationale Union zum Schutze des Gewerblichen Eigentums und das Deutsche Reich). Dr. F. Damme. A review of the work of the Union, and the effect which it may have upon patent and proprietary legislation in Germany. 4000 w. Zeitschr d Ver Deutscher Ing—Nov. 15, 1902. No. 52401 D.

Piecework.

Piecework in a Locomotive Erecting Shop. J. Korns. Gives suggestions based upon successful experience. 1000 w. Am Engr & R R Jour—Dec., 1902. No. 52-112 C.

Telephone Rates.

See Electrical Engineering, Communication.

Transportation.

The American Merchant Marine. A review of the present condition, with comparison with former record, and description of notable passenger steamers recently constructed. 2500 w. Sci Am—Dec. 13, 1902. No. 52313.

The Development of Transportation on the Great Lakes. Waldon Fawcett. A review of changes in size and character of vessels, growth in passenger travel, and other interesting statistics. 1400 w. Sci Am—Dec. 13, 1902. No. 52316.

Transport Systems.

Connections between Railway and Waterway Systems (Le Raccordement du Réseau Ferré et du Réseau Navigable). Paul Léon. A discussion of transport problems in France showing the advantages of harmonious action between the railways and the canal systems. 2500 w. Génie Civil—Dec. 6, 1902. No. 52426 D.

Trusts.

President Roosevelt and "the Trusts." Joseph S. Auerbach. Considers the views of Mr. Roosevelt as expressed in his addresses, and gives a suggestion. 7300 w. N Am Rev—Dec., 1902. No. 52094 D.

The Great Consolidations Called "Trusts." Peter S. Grosscup. A valuable address delivered before the students of the University of Nebraska, at Lincoln. 5500 w. R R Gaz—Dec. 19, 1902. No. 52509.

What Is Publicity? Henry C. Adams. Discusses its general, particular, and administrative significance in relation to the solution of the trust problem. 4000 w. N Am Rev—Dec., 1902. No. 52095 D.

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MARINE AND NAVAL ENGINEERING

Accidents

The Accident on H. M. S. "Bullfinch." Summary of evidence given at the inquiry into the breakdown of machinery on the Bullfinch taken from the judgment of Mr. Justice Kennedy. 6000 w. Engng—Nov. 21, 1902. No. 52076 A.

Boat Cranes.

The Construction of Boat Cranes (Beitrag zur Konstruktion von Bootskränen). J. Stieghorst. A discussion of the construction of davit cranes on ships for the most convenient lowering and hoisting of boats at sea. Serial. Part I. 2500 w. Schiffbau—Dec. 8, 1902. No. 52462 D.

Cruiser.

The Protected Cruiser "Bogatyr" (Der Geschützte Kreuzer "Bogatyr"). A detailed description of the protected cruiser built by the Vulkan Works at Stettin for the Russian government, giving especially details of the propelling machinery, water-tube boilers, etc. 4000 w. 3 plates. Zeitschr d Ver Deutscher Ing—Nov. 22, 1902. No. 52404 D.

Fire Apparatus.

Fire Extinguishing Apparatus for Ships. Brief illustrated description of the Clayton fire extinguishing apparatus, which uses sulphur dioxide. 2000 w. Prac Engr—Nov. 28, 1902. No. 52252 A.

Freighters.

The Two Great Freighters for the Pacific Trade. Illustrates and describes the interesting features of the 20,000-ton steamships building at New London, Conn., for the Pacific trade. 1400 w. Sci Am—Dec. 13, 1902. No. 52314.

French Navy.

New Vessels of the French Navy. Translated from *Illustrirte Zeitung*. Brief illustrated description of a recent battleship, cruiser and torpedo boat destroyer. 1000 w. Sci Am Sup—Dec. 20, 1902. No. 52397.

The French Naval Programme. An editorial review of the proceedings of the French government in regard to naval affairs. 2500 w. Engng—Nov. 28, 1902. No. 52189 A.

Insurance.

See Industrial Economy.

Lighthouse.

See Civil Engineering, Canals, Rivers and Harbors.

Liners.

The Latest of the Fast Transatlantic Liners. Illustrated description of the "Kaiser Wilhelm II." 1200 w. Sci Am—Dec. 13, 1902. No. 52315.

Naval Officers.

Naval Officers. An editorial review of the proposed changes in the personnel of the British navy by which executive engineering and marine officers will all receive the same education and training as cadets, and engineers will receive official rank. 2200 w. Engng—Dec. 12, 1902. No. 52565 B.

Oil Fuel.

Oil as Fuel in Warships. A review of Admiral Melville's report, with illustrations of burners tested. 3000 w. Engr, Lond—Nov. 21, 1902. No. 52077 A.

See also Mechanical Engineering, Steam Engineering.

Oil-Tank Steamer.

New Large Oil-Tank Steamer Captain A. F. Lucas. Illustrated description of an oil-carrying vessel now under construction. 2000 w. Marine Engng—Dec., 1902. No. 52310 C.

Oil-Fuel Installation on Steamship. J. M. Guffey. Illustrated description of a vessel transformed into a tank ship for carrying oil in bulk and for burning oil as fuel. 1500 w. Marine Engng—Dec., 1902. No. 52311 C.

Portsmouth Yard.

The Royal Dockyard at Portsmouth. W. Price. An illustrated description of the navy yard at Portsmouth, England, and a criticism of its engineering facilities and administration. 2400 w. Page's Mag—Dec., 1902. No. 52552 B.

Shipping Combine.

See Industrial Economy.

Steering Gear.

An Electric Steering Gear. An illustrated description of an electrically-controlled steering gear which Siemens Bros. & Co. have fitted on the large steam yacht "Valhalla." 1000 w. Elect'n, Lond—Dec. 12, 1902. No. 52530 A.

Electrical Steering Gear on the "Finland." Iilustrated description of the apparatus, designed by M. Pfatischer, which is an application of the principle of the Wheatstone bridge to the control of a ship's rudder. 2200 w. Elec Wld & Engr—Nov. 29, 1902. No. 52108.

Submarines.

Official Trials of Our Submarine Boats. Brief account of the gratifying results obtained in the trials of the "Adder" and the "Moccasin," two of the six submarines being constructed for the U. S. Navy. Ill. 900 w. Sci Am—Nov. 29, 1902. No. 52042.

Submarine Boats. Discusses the Hol-

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land, Lake, and Moriarty boats. 5000 w. Engng—Dec. 5, 1902. No. 52363 A.

Testing Tank.

Experimental Laboratory of the North German Lloyd. Condensed translation of a paper by Herr A. Schromm, in the *Austrian Weekly of Public Works*, describing the station at Bremerhaven. 1000 w. Eng Rec—Nov. 29, 1902. No. 52119.

Transportation.

See Industrial Economy.

Turbine Steamers.

Forthcoming Developments in the Marine Steam Turbine. Herbert C. Fyfe. A very well illustrated review of war ships, passenger steamers and pleasure yachts equipped with Parson's steam turbines. 5000 w. Page's Mag—Dec., 1902. No. 52555 B.

The Application of Turbine Propulsion to Passenger Vessels. Especially describes the "Queen Alexandra," with general discussion of the application to vessels. Ill. 1200 w. Sci Am—Dec. 13, 1902. No. 52319.

U. S. Navy.

America's Bid for Naval Supremacy. Archibald S. Hurd. Reviews briefly the history of the American navy, and the causes of the present lack of officers and men to serve all the ships built or in course of construction. 5000 w. Nineteenth Cent—Dec., 1902. No. 52370 D.

The United States Naval Engineering Report. Editorial review of the report of Admiral Melville. 2400 w. Engng—Nov. 21, 1902. No. 52075 A.

Ventilation.

The Ventilation of War Ships (Die Lüftung der Schiffsraume bei Kriegsschiffen). Otto Kratschmer. A discussion of the arrangement of ventilating pipes in connection with the maintenance of watertight compartments. 1200 w. Zeitschr d Ver Deutscher Ing—Nov. 22, 1902. No. 52405 D.

Yachts.

English Turbine-Propelled Yachts. Illustrations with particulars of the three high-speed yachts fitted with the Parsons marine steam turbine. 400 w. Sci Am—Dec. 13, 1902. No. 52318.

The Development of the Auxiliary Yacht. Illustrated description of the "Ariadne," with general remarks on this type of vessel. 1000 w. Sci Am—Dec. 13, 1902. No. 52317.

MECHANICAL ENGINEERING

AUTOMOBILES.

Accumulators.

See Electrical Engineering, Electro-Chemistry.

Boilers.

See Mechanical Engineering, Steam Engineering.

Carburetter.

An Automatic Carburetter for Internal Combustion Motors (Sur un Carburateur Automatique pour Moteurs à Explosions). A. Krebs. Illustrated description of a self-regulating carburetter, well adapted for automobile vehicles or for stationary motors. 1500 w. Comptes Rendus—Nov. 24, 1902. No. 52441 D.

Coupe.

First Peugeot Coupé Imported into the United States. Illustrates and describes a luxurious novel motor cab. 900 w. Auto & Motor Rev—Dec. 13, 1902. No. 52296.

Crestmobile.

The Automobile Carriage in Its Simplest Form. Brief illustrated description of a vehicle which aims at simplicity in design. 600 w. Auto & Motor Rev—Dec. 13, 1902. No. 52297.

Engines.

Two-Cycle Automobile Engines. E. W. Roberts. On their adaptability to automobile propulsion. 1200 w. Sci Am—Nov. 29, 1902. No. 52044.

Fire Engines.

Some Foreign Motor Fire Engines. Illustrated descriptions of fire apparatus run by alcohol, steam and electricity. 1200 w. Munic Jour & Engr—Dec., 1902. No. 52149 C.

French Cars.

Industrial Motor Cars in France. The first of a series of articles on the progress shown in these vehicles as illustrated at the recent trials. Describes and illustrates some of the cars. 2100 w. Engr, Lond—Dec. 5, 1902. Serial. 1st part. No. 52367 A.

Gasoline Vehicles.

Gasoline Motor Car in the Canadian Rockies. Illustrates and describes an observation car built for use of guests in the Rocky and Selkirk mountains. 800 w. Loc Engng—Dec., 1902. No. 52155 C.

The Sources of Noise in Gasoline Vehicles. Albert L. Clough. Considers the engine noises, the transmission gear noises

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and running gear noises. 2500 w. Horseless Age—Dec. 3, 1902. No. 52152.

Generating Set.

Improved Generating Set for Mixed Automobiles (Nouveau Groupe Electrogène pour Automobiles Mixtes). J. A. Montpellier. Describing a combination of de Dion Bouton gasoline motor and an electric generator for use on an electric automobile. 1500 w. L'Electricien—Dec. 6, 1902. No. 52481 B.

Hill Climbing.

The Eagle Rock Hill Climbing Trial. An account of the contest held by the New Jersey Automobile Club on Thanksgiving Day. Ill. 1700 w. Horseless Age—Dec. 3, 1902. No. 52154.

Motor Cycles.

Motor Cycle Matters. A. J. Wilson. Remarks on the exhibits at the Stanley and National Cycle shows, and the features of interest in the designs. 2200 w. Autocar —Nov. 29, 1902. No. 52176 A.

Petrol Cars.

The "Watsonia" Petrol Cars. Illustration, with a description of these cars, which are said to rank among the best of their class. 800 w. Auto Jour—Nov. 29, 1902. Serial. 1st part. No. 52177 A.

Review.

Automobiles (Le Automobiles). M. Forestier. A general review of the present state of automobile construction based on the exhibits at the Paris Exposition of 1900. 15,000 w. Ann des Ponts et Chausées—2 Trimestre, 1902. No. 52-447 E+F.

Steam Car.

The Chelmsford Steam Car. An illustrated description of a new steam car, fitted as a private omnibus. 1600 w. Horseless Age—Dec. 6, 1902. No. 52373.

The Chelmsford Steam Car. Illustrates and describes the mechanical details of this vehicle. 1200 w. Autocar—Nov. 29, 1902. Serial. 1st part. No. 52175 A.

Traction Engine.

The "Pedrail" Traction Engine. An illustrated description of an engine invented by B, J. Diplock which aims to imitate in principle the structure of the horse. 1300 w. Transport—Nov. 28, 1902, 1902. No. 52170 A.

Truck.

Morgan Motor Truck. Illustrates and describes a 10-ton truck made in Worcester, Mass. The steam is generated by oil, the boiler of the water-tube type. 3300 w. Auto Topics—Dec. 13, 1902. No. 52-300.

The Ten Ton Morgan Steam Truck. An illustrated detailed description. 1600 w. Horseless Age—Dec. 3, 1902. No. 52153.

Some Foden Steam Wagons. Illustrations of a covered van, tipping wagons, and haulage wagon, with brief description. 800 w. Autocar—Nov. 22, 1902. No. 52052 A.

Voiturette.

The "Traveller" Voiturette. Illustrated description of a machine that has proved itself reliable and durable. Its chief features are noted. 1800 w. Auto Jour—Nov. 22, 1902. No. 52053 A.

Winter Service.

Practical Winter Use of Automobiles. Harry B. Haines. An account of some winter experiences in using a gasoline vehicle. 2400 w. Horseless Age—Dec. 17, 1902. No. 52391.

HYDRAULICS.

Centrifugal Pumps.

Flow Through Centrifugal Pumps. Jas. Alex. Smith. Read before the Victorian Inst. of Engrs. Illustrated notes on some experimental researches on internal flow in centrifugal pumps and allied machines. 3800 w. Engng—Dec. 5, 1902. No. 52-366 A.

Notes on some Experimental Researches on Internal Flow in Centrifugal Pumps and Allied Machines. James Alex. Smith. Paper read at Victorian Inst. of Engrs. (Revised.) An illustrated article showing simple means of recording photographically the course of the fluid current in typical equivalents of hydraulic machines, especially in the rotary parts. 3500 w. Sci Am Sup—Nov. 29, 1902. No. 52047.

Excavation.

The Cost of Hydraulic Excavation for Embankments and for Placer Mining. Abstracts of recent papers bearing upon this class of work are given with comments and tabulated information concerning cost. 2200 w. Eng News—Nov. 27, 1902. No. 52027.

Flow.

Some Characteristics of the Flow of Water in Channels of Varying Cross-Section. T. E. Stanton. An account of experiments undertaken to gain information concerning (1) the effect of the form of the channel; and (2) the effect of the angle of divergence on the loss of head involved. 2000 w. Engng—Nov. 21, 1902. No. 52071 A.

Hydro-Electric Plant.

See Electrical Engineering, Generating Stations.

Pumps.

High-Speed Pumps (Pompes à Grand Vitesse). M. Lecuir. A discussion of the

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action of valves and mechanism of high-speed power pumps by means of which shock may be minimised, with examples of recent construction. 6000 w. Revue de Mécanique—Nov. 30, 1902. No. 52-435 E+F.

The Klein High-Speed Pump (Pompe Express à Grande Puissance Système Klein). O. Diemer. With illustrations showing the arrangement of valves and differential plunger, permitting speeds of 200 strokes per minute without shock. 1000 w. Revue Technique—Nov. 25, 1902. No. 52427 D.

Sault Ste. Marie.

Compensating Works at the Sault Canal. Waldon Fawcett. Illustrates and describes these interesting works, designed to equalize conditions by retarding and diverting from the rapids in the St. Mary's river a volume of water equal to the flow through the power canal. 1200 w. Am Mfr—Dec. 11, 1902. No. 52303.

The Giant Growth of the "Soo." Cy Warman. An illustrated account of the great industrial plants created by the power canals of Sault Sainte Marie. 2700 w. Rev of Revs—Dec., 1902. No. 52138 C.

Turbines.

Modern Turbine Practice and the Development of Water Power. John Wolf Thurso. Reviews the development of the turbine in Europe and America, present American turbine practice, types for low and high heads, general construction, etc. Ill. 10,000 w. Eng News—Dec. 4, 1902. No. 52166.

The Turbine Equipment of the "Soo." Brief illustrated description of this important development of water power. 700 w. Min Rept—Nov. 27, 1902. No. 52100.

Water Meter.

A Turbine Water Meter. An illustrated description of a water-wheel flow recorder for recording the discharge of a turbine, taking into account the effect of the degree of gate opening and of change of head. Designed by George I. Rockwood and C. M. Allen. 800 w. Eng Rec—Dec. 27, 1902. No. 52579.

Water Motor.

How to Make a Water Motor. R. E. Davall. Illustrated directions for a motor made by simple tools. 800 w. Sci Am Sup—Dec. 13, 1902. No. 52329.

Water Power.

An analysis of the "Commercial" Value of Water-Power per Horse-Power per Annum. A. F. Nagle. A method of calculating the value of a water-power for power purposes. 4500 w. Trans Am Soc of Mech Engrs, No. 0963—Dec., 1902. No. 52334 C.

Weirs.

See Civil Engineering, Canals, Rivers and Harbors.

MACHINE WORKS AND FOUNDRIES

Automobile Works.

Some Motor Car Works. Begins an illustrated review of the English works for the building of motor vehicles, commenting on the rapid development of the industry. The present article describes the Thornycroft Works. 3600 w. Engr, Lond—Nov. 28, 1902. No. 52184 A.

Bearings.

Friction in High Speed Bearings (Die Reibungs verhältnisse in Lagern mit Hoher Umfangs geschwindigkeit). O. Lasche. A review of early and recent experiments, with data and results of tests at the A. E. G., confirming the investigations of Beauchamp Tower. Serial, Part I. 4500 w. Zeitschr d Ver Deutscher Ing—Dec. 13, 1902. No. 52411 D.

Transmission Bearings with Automatic Lubrication (Transmissionslager mit Selbstätter Schmierung). R. Kablitz. With descriptions of various forms of bearings, pillow blocks, and hangers; also data and results of efficiency tests. 3000 w. Zeitschr d Ver Deutscher Ing—Dec. 6, 1902. No. 52409 D.

Boiler Shops.

The Boiler Shops of the Babcock & Wilcox Company. Illustrates and describes the new plant at Bayonne, N. J., and also describes the construction of these boilers, which are of the sectional, water-tube type. 5000 w. Eng Rec—Dec. 6, 1902. No. 52243.

Calipers.

The Koopman Calipers. Ferd. Wertheim. An illustrated description of several calipers of superior design. 500 w. Am Mach—Dec. 4, 1902. No. 52163.

Cost Keeping.

See Industrial Economy.

Dies.

Eye-Glass Strap Dies. Frank Greiner. Drawings and descriptions of dies used in manufacturing these straps. 1500 w. Am Mach—Dec. 4, 1902. No. 52165.

Electrical Driving.

See Electrical Engineering, Power Applications.

Electrical Works.

The British Thomson-Houston Company's Works. Illustrated description of large works for the manufacture of electrical machinery. 5000 w. Tram & Ry Wld—Nov. 13, 1902. No. 52129 B.

Foundries.

Foundry. R. H. Palmer. A review of

the many improvements introduced during the last quarter of a century. 3700 w. Am Mach—Dec. 4, 1902. No. 52164.

The Foundry of the Saco & Pettee Machine Shops, Biddeford, Maine. An illustrated detailed description of this plant and its methods. 3500 w. Foundry—Dec., 1902. No. 52049.

Foundry Management.

Foundry Management in the New Century. Robert Buchanan. Mr. Buchanan's second paper discusses crane service and transport appliances for the foundry floor, with numerous characteristic illustrations. 4500 w. Engineering Magazine—January, 1903. No. 52487 B.

Foundry Output.

See Industrial Economy.

Foundry Practice.

Some Notes on English and Continental Foundry Practice. G. E. Pickup. An account of experiences, mostly in Great Britain, in a study of methods used for light castings. 1400 w. Foundry—Dec., 1902. No. 52050.

Hardening.

Shape as Affecting Hardening. Thomas Lovekin. Discusses the question of the effect of hardening upon the shape of steel articles, illustrating by an example where a slight change in construction made cracking impossible. 900 w. Am Mfr—Dec. 11, 1902. No. 52304.

Machine Tools.

A Large Horizontal Boring, Drilling and Milling Machine. An illustrated description of a machine of the heaviest type. 1500 w. Am Mach—Dec. 11, 1902. No. 52312.

Machine Tools. Jas. K. Cullen. On the present design, application and utility of these tools. Also discussion. 9500 w. W Ry Club—Nov. 18, 1902. No. 52338 C.

Machine Tools at the National Show. An illustrated review of the machine tools on exhibition at the Crystal Palace, London. 2700 w. Engng—Nov. 28, 1902. No. 52188 A.

Marine Works.

The Wallsend Slipway and Engineering Company. An illustrated description of British works for ship repairing and the building of marine engines and boilers. Also gives information concerning the important tools and some of the work undertaken. 2700 w. Engng—Nov. 28, 1902 No. 52187 A.

Piece Work.

See Industrial Economy.

Pneumatic Tools.

Principles, Care and Operation of Pneumatic Hammers and Tools. Refers more particularly to the construction and operation of the Boyer, Keller pneumatic hammers, and gives suggestions for the care of tools. 2800 w. Mod Mach—Dec., 1902. No. 52141.

Screw Machines.

The National-Acme Manufacturing Co. and Its Automatic Screw Machines. An illustrated article giving details of the manufacturing operations and of the machines. 2400 w. Ir Trd Rev—Dec. 4, 1902. No. 52158.

Springs.

A Diagram for Helical Springs. George F. Summers. Gives a chart for finding the size of helical springs, having given the properties, with explanation of its use. 700 w. Am Mach—Dec. 18, 1902. No. 52500.

Wastes.

Workshop Wastes: Time. W. J. May. Discusses some of the causes of wasted time of workmen. 1200 w. Prac Engr—Nov. 28, 1902. No. 52251 A.

Welding.

Rapid and Economical Method of Welding Locomotive Frames. Illustrates and describes the method of welding fractured frames in use in the shops of the Southern Pacific, which gives economy in cost and time. 1000 w. Ry & Engng Rev—Dec. 6, 1902. No. 52260.

MATERIALS OF CONSTRUCTION.

Alloys.

Alloys of Copper and Magnesium (Sur les Alliages de Cuivre et de Magnesium). O. Boudouard. A record of a systematic series of tests of copper-magnesium alloys, with a brief account of their properties. 1000 w. Comptes Rendus—Nov. 10, 1902. No. 52438 D.

Chemical Analysis.

The Determination of the Value of Materials by Chemical Analysis (Die Chemische Analyse als Mittel Zur Bestimmung der Güte des Materials bei der Abnaline). O. Knaudt. A comparison of the results of physical tests with those obtained from chemical analysis, with especial reference to iron and steel. 1200 w. Zeitschr d Ver Deutscher Ing—Nov 15, 1902. No. 52402 D.

Malleable Castings.

Malleable Cast Iron. H. E. Diller. Describes the processes by which malleable iron is produced and gives information related. 1000 w. Jour Am Found Assn—Dec., 1902. No. 52142.

Nickel Alloys.

The Properties of Nickel-Iron and Nickel-Iron-Carbon Alloys (Die Eigenschaften von Nickel-Eisen und Nickel-Eisen-Kohlenstoff Legirungen). Data and

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results of tests made by the *Verein zur Beförderung des Gewerbfleisses.* 2500 w. Stahl u Eisen—Dec. 1, 1902. No. 52458 D.

Strained Materials.

A Possible Explanation of the Phenomena Caused by Repetitions of Stress. F. Foster. Read before the Owens College Engng Soc. A study of the effects of cyclical repetitions of stress on a material, and associated phenomena. 2500 w. Mech Engr—Nov. 22, 1902. Serial, 1st part. No. 52060 A.

MEASUREMENT.

Indicators.

The Indicator as an Educator in Steam Engine Practice. S. J. Dillon. On the importance of understanding the indicator. Gives explanation of four cards. 800 w. Loc Engng—Dec., 1902. No. 52225 C.

Indicator Springs.

Testing Indicator Springs. Illustrated description of new apparatus at the New York Navy Yard for this purpose, giving details of construction and methods of testing. 2200 w. Mach, N Y—Dec., 1902. No. 52161.

Mean Effective Pressure.

A Graphical Determination of Mean Effective Pressure. Sidney Graves Koon. A series of curves, with explanation, of mean effective pressure in steam-engine cylinders, for the purpose of facilitating the preliminary design of engines. 800 w. Sibley Jour Mech Engng—Dec. 1, 1902. No. 52584 C.

POWER AND TRANSMISSION.

Air Compressor.

Air Compressor for the Harpener Mining Company. An illustrated description of a compound air compressor, with Collmann valves, made by Schüchtermann and Kremer, of Dortmund, and exhibited at Düsseldorf. 1 plate. 700 w. Engng—Dec. 12, 1902. No. 52563 B.

Efficiency and Capacity Test of the Ingersoll-Sergeant Drill Co.'s Plant Installed for the Boston Transit Commission, Boston, Mass. R. S. Carter. Illustrated description of air-compressor plant to be used in driving a tunnel by the shield method, and record of tests. 1800 w. Compressed Air—Dec., 1902. No. 52536.

Belts.

Estimating Length of Driving Belts. Gives a graphical method and chart, either of which can be applied to the solution of these problems, with a formula for the length of crossed belts. 1200 w. Am Mach—Dec. 18, 1902. No. 52501.

Compressed Air.

Air Washer for Compressor Inlets. An illustrated description of a device for removing the dust and cleaning the air. 400 w. Compressed Air—Nov., 1902. No. 52372.

Compressed Air as a Transportation Agent. Waldon Fawcett. Considers some of the fields where this form of mechanical haulage is especially useful, giving illustrated descriptions of the locomotives used. 900 w. Sci Am—Dec. 13, 1902. No. 52324.

Compressed Air in the Foundry and Machine Shop. W. L. Saunders. An exhaustive study of the numerous uses of compressed air for sand blast, ramming, hammers, hoists, pneumatic tools, moulding machines, and other uses in machine works and foundries. 5000 w. Compressed Air—Dec., 1902. No. 52499.

Conveyor.

A Vibrating Conveyor System (Propellerrinnen und Wurfgetriebe). H. Marcus. An illustrated description of a device for conveying coal, grain, and similar materials in a vibrating open trough operated by a quick return crank movement. 3000 w. Zeitschr d Ver Deutscher Ing.—Nov. 29, 1902. No. 52407 D.

Driving Chains.

The Renold Silent Chain in Connection with Machine and Structural Tools. J. O. Nixon. An illusrated article setting forth the advantages of these chains. 1200 w. Mach, N Y—Dec., 1902. No. 52159.

Gears.

Worm Gearing. C. F. Blake. Notes on the design of self-locking worm gears. Ill. 2500 w. Mach, N Y—Dec., 1902. 52160.

Shafting.

Hanging New and Lining Up Old Shafting. D. B. Dixon. Directions for this work with remarks on care needed in determining the diameter of the shafting, the bearings, etc. 2200 w. Am Mfr—Dec. 4, 1902. No. 52146.

SPECIAL MOTORS.

Diesel Motor.

The American Type Diesel Engine. An illustrated explanation of this form of engine. 1200 w. Elec Rev, N Y—Dec. 6, 1902. No. 52214.

Explosive Mixtures.

Some New Work on Properties of Explosives Mixtures. Charles E. Lucke. An illustrated account of experimental studies of explosive mixtures for heat engines. 5000 w. School of Mines Quar—Nov., 1902. No. 52559 E.

Gas Engines.

Application of Blast-Furnace and Producer Gas to Power Development. C. A. Dawley. A general review of the subject, with two illustrations of gas engines. 2400

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w. Sibley Jour Mech Engng—Dec., 1902. No. 52586 C.

Blast-Furnace Gas Engines and Their Work. Extracts from a critical and descriptive paper by Director Reinhardt of Dortmund, Germany, presented at meeting of the Verein Deutscher Eisenhuettenleute, giving much new information. 2800 w. Ir Age—Dec. 4, 1902. Serial, 1st part. No. 52134.

Gas Engine Diagrams. W. H. Booth. An illustrated discussion of gas-engine indicator diagrams, and a comparison with steam engine diagrams. 1600 w. Elec Rev, Lond—Dec. 12, 1902. No. 52545 A.

Gas Engines for Electric Stations. G. H. Baillie. A general discussion of the operation of electric stations by gas engines and a comparison with steam engines. 3000 w. Engr, Lond (Elec Engng Sup)—Dec. 12, 1902. No. 52541 A.

Internal Combustion Motors and their Operation with Producer Gas, Furnaces Gases, etc. (Verbrennungs Kraftmaschinen und deren Betrieb mit Kraftgas, Hochöfengas, etc.). Joh. Körting. An extensive review of large power gas installations, with details of engines and producer plants. 6000 w. Glasers Annalen—Dec. 1, 1902. No. 52421 D.

Suction Producers for Gas Engines. Abstract translation of a paper by Herr J. Korting in the *Journal für Gasbeleuchtung*. Gives an illustrated description of the Korting power-gas plant and discusses the suction generators for making producer gas without the aid of a boiler. 4000 w. Jour Gas Lgt—Nov. 25, 1902. No. 52174 A.

Suction Gas Producer for Anthracite (Gazogène à l'Anthracite pas Aspiration). E. François. Illustrating a convenient form of gas producer with reversed draft, suitable for generating lean fuel gas for medium and small sized gas engines. 8000 w. 4 plates. Rev Univ des Mines—Nov., 1902. No. 52446 G.

The Koerting Gas Engine. Illustration with description of this large gas engine and its operation. 1200 w. R R Gaz—Dec. 5, 1902. No. 52222.

The Use of Blast Furnace Gas in Gas Engines. Cecil A. Cochrane. A paper before the Cleveland Institution of Engineers, giving a description of a 600-horse-power Cockerill gas engine, installed at the Ormesby Iron Works, Middlesborough, Eng., and the experience in operating it with blast-furnace gas. Also editorial review. Serial. Part I. 4000 w. Engng—Dec. 12, 1902. No. 52566 B.

Three-Cylinder Compound Gas Engine. An illustrated description of a 100-horse-power compound gas engine constructed by Clarke, Chapman and Co., under Mr. Butler's patents, with a set of indicator cards. 600 w. Engr, Lond—Dec. 12, 1902. No. 52540 A.

See also Electrical Engineering, Generating Stations; Mining and Metallurgy, Iron and Steel.

Mond Gas.

See Gas Works Engineering.

STEAM ENGINEERING.

Balancing.

The Balancing of Rolling Mill Engines. George Service. Read before the West of Scotland Ir. & Steel Inst. Considers (1st) the work actually being performed by the engine; (2d) the actions taking place in the various parts of the engines and their effect on the engine as a whole, while performing this work. 3000 w. Ir & Coal Trds Rev—Nov. 28, 1902. No. 52249 A.

Boiler Explosion.

Boiler Explosion at Swift & Co.'s Plant, Chicago. An illustrated account of an accident involving great loss of life and destruction of property. 2300 w. Steam Engng—Dec. 10, 1902. No. 52306.

Boilers.

A Competitive Test of Steam Boilers. Reports a competitive test at the power station of the Rapid Transit Co., in Philadelphia, of a Parker boiler and the regular Babcock & Wilcox boiler. 4000 w. Eng News—Nov. 27, 1902. No. 52036.

Computing the Strength of Tubular Boilers. Charles L. Hubbard. Directions for calculating the resistance of a boiler to internal pressure, illustrating by example. 1800 w. Am Elect'n—Dec., 1902. No. 52246.

Flash Steam Generators. J. S. V. Bickford. Notes on the writer's experience in designing and using such generators. 3500 w. Horseless Age—Dec. 17, 1902. No. 52392.

Modern Production of Boiler Draught and Its Influence on Fuel Consumption and Steam Production. W. L. Sutcliffe. Paper before the Manchester Assn. of Engrs. A discussion of mechanical or machine draft producers. Does not deal with steam jet apparatus. 1700 w. Mech Engr—Nov. 29, 1902. No. 52254 A.

Naval Tests of a Water-Tube Boiler. An illustrated account of tests made at Washington, D. C., of a Hohenstein boiler, one series with coal and another with oil fuel. The trials were made by U. S. naval officers, in a steel house similar to the fire room of a cruiser, and are recorded in Admiral Melville's annual report. Tables. 1500 w. Eng Rec—Dec. 20, 1902. No. 52571.

The Management and Working of

Steam Boilers. William H. Fowler. Treats of the arrangement, working and equipment of steam boilers and auxiliary appliances from the practical standpoint of the steam user, the superintending engineer, the boiler inspector, and the attendant. Ill. 1800 w. Mech Engr—Nov. 22, 1902. Serial. 1st part. No. 52058 A.

Calorimetry.

The Effect of Impurities in Compressed Oxygen upon Combustion in the Calorimetric Bomb (Sur les Impuretés de l' Oxygène Comprimé et sur leur Rôle dans les Combustions Opérées au Moyen de la Bombe Calorimetrique). M. Berthelot. An examination of the impurities found in commercial compressed oxygen, showing especially the possible errors produced by the presence of hydrogen, when used in the calorimetric bomb. 1500 w. Comptes Rendus—Nov. 17, 1902. No. 52439 D.

Chimney.

The Demolition of a 150-Ft. Brick Chimney by Dynamite. W. J. Douglas. An illustrated account of the means recently adopted at Washington, D. C., to demolish a brick chimney, with approximate cost of the work. 1000 w. Eng News—Dec. 4, 1902. No. 52168.

Condensers.

Central Condensers (Zentral-Kondensationen). H. Dubbel. An illustrated description of the central condensing systems shown at the Düsseldorf exposition. 1800 w. Zeitschr d Ver Deutscher Ing—Nov. 29, 1902. No. 52408 D.

Continental Practice.

Steam Engineering in Continental Europe. A. Bollinckx. Reports an unsettled period, and reviews the improvements in course of trial. 900 w. Power—Dec., 1902. 52268 C.

Corliss Engines.

The Early History of the Corliss Engine in the United States. George R. Phillips. Read before the Engine B'ld'rs Assn. 4800 w. Ir Age—Dec. 4, 1902. No. 52136.

Drips.

The Disposal of Drips. C. G. Robbins. Considers the handling of "low-pressure" and "high-pressure" drips of condensed steam. Ill. 2500 w. Power—Dec., 1902. No. 52271 C.

Engine Design.

Freaks and Fallacies in Steam Engine Design. Egbert P. Watson. Accounts of some of the fallacious designs which have been brought out to revolutionize steam engineering practice; showing the only true tests to be fuel consumption and accurate power measurement. 2500 w. Engineering Magazine—January, 1903. No. 52486 B.

Engines.

Recollections of the Early Days of the High Speed Engine Industry. John E. Sweet. Read before the Engine B'ldrs. Assn. of the U. S. 3500 w. Ir Age—Dec. 11, 1902. No. 52256.

Engine Tests.

Final Report of the Committee Appointed to Standardize a System of Testing Steam Engines. 20,000 w. Ill. Trans Am Soc of Mech Engrs, No. 0957—Dec., 1902. No. 52088 D.

Discussion on Report of Committee on Standardizing Engine Tests. All discussion that has been offered on the report at meeting and in writing. 19,800 w. Ill. Trans Am Soc of Mech Engrs, No. 0958—Dec., 1902. No. 52089 D.

Firing.

On Firing with Soft Coal. Re-print of an article published by this same paper thirteen years ago, on the management of soft coal fires. Ill. 1200 w. Locomotive—Oct., 1902. No. 52262.

Fuels.

Liquid Fuel. Presents the advantages over coal and coke, and thinks it only needs to have the furnaces for its use correctly designed to demonstrate its great economy. 800 w. Am Engr & R R Jour—Dec., 1902. No. 52113 C.

Recent Developments in the Economy and Variety of Fuel. E. H. S. Bailey. Remarks on recent investigations for producing greater saving in combustion, and the development of new fuels. 1800 w. Pro Age—Dec. 15, 1902. No. 52339.

The Possibilities of New Fuel. George Ethelbert Walsh. Concerning the study of available fuels brought about by the recent strike, and the indications of more economical use, and preparations for future power. 2500 w. Power—Dec., 1902. No. 52267 C.

The Present State of the Question of Liquid Fuel. Considers briefly the economy, the difficulty of satisfactorily burning moderate quantities of oil, the uses, etc. 2000 w. Jour Gas Lgt—Dec. 2, 1902. No. 52375 A.

Generating Sets.

See Electrical Engineering, Generating Stations.

Governor.

Robinson's Shaft Governor. An illustrated description of a spring shaft governor for steam engines. 400 w. Engng—Dec. 12, 1902. No. 52567 B.

Great Britain.

The Present Condition of Steam Engineering in Great Britain. W. H. Booth. Reviews the changes of the past twenty years, criticising some points. 4300 w. Power—Dec., 1902. No. 52270 C.

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Heating.

Heating the Washington Heights Free Library, New York. An illustrated description of a steam-heating system, principally by indirect radiation. Plans. 1200 w. Eng Rec—Dec. 27, 1902. No. 52581.

Steam Heating. George Bennett. A review of the methods of heating buildings by steam, describing each briefly and discussing the production and distribution of heat. 3000 w. Engr, U S A—Dec. 1, 1902. No. 52150.

Heat Transmission.

The Relation of Heat Emission to Steam Pressure (Zur Generellen Regelung der Wärmeabgabe der Heizkörper bei Niederdruck durch die Höhe der Dampfspannung). O. Hunaeus. A discussion of Rietschel's formula, showing its applicability to steam and hot-water heating. 2500 w. Gesundheits-Ingenieur—Nov. 15, 1902. No. 52476 B.

The Relation of Heat Emission to Steam Pressure (Zur Generellen Regelung der Wärmeabgabe der Heizkörper bei Niederdruck durch die Höhe der Dampfspannung). Prof. Rietschel. A review of the use of his formula by Herr Hunaeus. 2500 w. Gesundheits-Ingenieur—Nov. 30, 1902. No. 52477 B.

The Transmission of Heat Through Heating Surfaces (Ueber den Wärmedurchgang durch Heizflächen). L. Austin. Data and results of tests made at the Reichsanstalt, with description of the apparatus. 3000 w. Zeitschr d Ver Deutscher Ing—Dec. 13, 1902. No. 52412 D.

Indicators.

See Mechanical Engineers, Measurement.

Lubrication.

Automatic Cylinder Lubrication. C. G. Robbins. Discusses the hydrostatic lubricator, stating objections to its use, and describes "pressure" systems in common use. Ill. 1800 w. Power—Dec., 1902. No. 52272 C.

Lubrication. William F. Parish, Jr. Abstract of a paper presented to the New England Cotton Mfrs. Assn. Considers the selection of oils; cylinder, engine, dynamos, and shafting lubrication. 3500 w. Power—Dec., 1902. No. 52273 C.

Mechanical Draft.

Mechanical Draft for Modern Steam Boiler Plants. S. R. Sheldon. Considers the opportunities for economy by the application of mechanical draft, and related subjects. 2200 w. Can. Engr—Dec., 1902. No. 52207.

Oil Fuel.

See Marine Engineering.

Pipe Covering.

Steam Pipe Covering and Its Relation to Station Economy. H. G. Stott. Read before the Assn. of Edison Ill. Co.'s. Results of a series of tests made in the interest of the Manhattan Ry. Co. Describes method of testing and discusses results. 3300 w. Elec Rev, N Y—Nov. 29, 1902. No. 52106.

Pulverized Coal.

The Rowe System of Burning Pulverized Coal. An illustrated description of a system using bituminous slack under the boilers in the works of the C. O. Bartlett & Snow Co., of Cleveland, Ohio. 500 w. Eng Rec—Dec. 20, 1902. No. 52574.

Refuse Destructors.

See Civil Engineering, Municipal; and Electrical Engineering, Generating Stations.

Rotary Engine.

The Patschke Rotary Steam Engine (Die Rotations-Dampfmaschine System Patschke). With numerous illustrations of details for a rotary engine of the radial eccentric-arm type. 1500 w. 1 plate. Glückauf—Dec. 6, 1902. No. 52456 D.

Smoke Prevention.

The Smoke Problem and Its Possibilities. W. C. Popplewell. A discussion of the methods for preventing smoke, and an illustrated description of several mechanical stokers. 6000 w. Feilden's Mag—Dec., 1902. No. 52557 B.

Speed Recorder.

Apparatus for Obtaining a Continuous Record of the Position of an Engine Governor and the Speed of the Engine which It is Governing. Joseph C. Riley. Describes experiments performed at Nason College, Birmingham, England, on the action of governors when detached from their engines, and also a similar set of experiments at the Massachusetts Inst. of Technology. Ill. 4800 w. Trans Am Soc of Mech Engrs, No. 0971—Dec., 1902. No. 52087 C.

Steam Piping.

High Pressure Steam Piping. William Andrews. Read before the Engine B'ldrs. Assn. of the U. S. Reviews briefly the development of the past 20 years, and discusses the design, material, and the disposing of the water. 2400 w. Ir Age—Dec. 11, 1902. No. 52258.

Steam Turbines.

Steam Turbines: With Special Reference to the De Laval Turbine. Konrad Anderson. Read before the Inst. of Engrs. & Shipbuilders in Scotland. Illustrates and describes the construction and working of the Parsons, De Laval and Rateau turbines. 2500 w. Mech Engr—Dec. 6, 1902. Serial. 1st part. No. 52379 A.

We supply copies of these articles. See page 817.

The Present Development of the Steam Turbine. Edwin Yawger. Read at the Columbus meeting of the Ohio Elec. Assn. An illustrated article describing the action and mechanical details. 1500 w. Elec Wld & Engr—Dec. 6, 1902. No. 52265.

See also Marine Engineering.

Superheating.

Superheated Steam. E. H. Foster. From a paper before the Engine Bldrs' Assn. Considers the advantages and disadvantages of superheating, describes the Schmidt system, the benefits of moderate superheating, and the use of superheated steam. 3000 w. Ir Age—Dec. 4, 1902. No. 52135.

Valve Seats.

The Boring of Corliss Valve Seats (Alésage des Glaces Circulaires des Cylinders à Distribution Corliss). M. Chand. With illustrations of forms of valve seats, and details of portable machine for reboring them in position. 2500 w. Revue Technique—Nov. 25, 1902. No. 52430 D.

Vibrating Engine.

The Sleeper Patent Steam Engine. G. D. Hartley. Illustrates an engine recently invented by Frank H. Sleeper, of Montreal, that has many novel features. 1800 w. Can Elec News—Dec., 1902. No. 52299.

MISCELLANY.

Aeronautics.

The Langley Aërodrome. An illustrated article describing this flying machine. The present number is a reprint of papers from the Smithsonian report for 1900, and from McClure's Magazine. 4400 w. Sci Am Sup—Nov. 29, 1902. Serial. 1st part. No. 52046.

Combustion.

The Temperature of Inflammation and Combustion of the Three Varieties of Carbon (Sur la Temperature d'Inflammation et sur la Combustion, dans l'Oxygéne, des Trois Variétés de Carbone). H. Moissan. A detailed study of the combustion of carbon in oxygen, including experiments with diamond, graphite, and amorphous carbon. 2000 w. Comptes Rendus —Dec. 1, 1902. No. 52442 D.

Compression.

Critical Points and their Importance in the Compression of Gases (Die Kritischen Daten und ihre Bedeutung für die Kondensation der Gase). Dr. Clemens Schaefer. A discussion of the influence of critical temperatures upon the behavior of gases under pressure. 3000 w. Zeitschr d Ver Deutscher Ing—Dec. 13, 1902. No. 52413 D.

Heating.

Heating and Ventilating the Akron, O., Jail. Illustrated description of a building which is a departure from the general prison plan, and of its combined forced and inducted hot air system of heating and ventilating. 2000 w. Eng Rec—Nov. 29, 1902. No. 52123.

The Reck System of Hot Water Heating (Die Warmwasserheizung System Reck). Ernst Schiele. The circulation is maintained by a form of jet pump operated from the heating boiler. Details of the system and its connections are given. Two articles, 4000 w. Gesundheits—Ingenieur—Nov. 15, 30, 1902. No. 52475 each B.

Ventilation and Heating in a Philadelphia Department Store. Illustrated description of methods adopted for heating a large building when each floor is practically a single room. A combined plenum and exhaust system. 3500 w. Eng Rec—Dec. 13, 1902. No. 52349.

Wood Furnace Heating in Nova Scotia. An illustrated description of arrangements for heating a building with a wood hot air furnace. 1800 w. Metal Work—Nov. 29, 1902. No. 52041.

Refrigeration.

Different Methods of Producing Cold. The Absorption and Compression Systems. Oswald Gueth. Presented before the James Watt Assn., N. A. S. E. The first of three lectures on this subject. 5700 w. Engr, U S A—Dec. 1, 1902. No. 52151.

Shutting Down an Ice Plant. William Nottberg. Illustrated directions for the proper care of the plant. 1400 w. Power—Dec., 1902. No. 52269 C.

MINING AND METALLURGY

COAL AND COKE.

Aguilar District.

Aguilar Coal and Oil District. Prof. Arthur Lakes. A description of the geology, the thickness and quality of the coal veins, and the indications of oil in this field in Colorado and New Mexico. 3300 w. Mines & Min—Dec., 1902. No. 52196 C.

Anthracite.

The Anthracite of the Third Hill Mountain, West Virginia. William Griffith. Situation, topography and geology of this region. 4500 w. Jour Fr Inst—Dec., 1902. No. 52341 D.

Briquetting.

Apparatus for Compressing Coal before

Coking (Installation pour la Compression du Charbon avant sa Transformation en Coke). With illustrations of the briquetting plant of Kuhn & Co. of Bruch, with plate of details. 1200 w. 1 plate. Génie Civil—Nov. 15, 1902. No. 52423 D.

By-Products.

Plant for Saving Coke By-Products. Abstract translation of an article by Dr. Bertelsmann, in the *Zeitschrift für Berg-Hutten und Salinenwesen*. Describes the extension of the coal distillation plant at the Matthias Stinnes mine in Carnap, Germany. 2800 w. Mines & Min—Dec., 1902. No. 52199 C.

Coal Cleaning.

Studies on Coal Washing. L. Moulan, in *Soc. Ingen. Ecole d'Industre du Hainaut*. Deals with the operation from the standpoint of the management of the washing water and the recovery of the sludge. Ill. 1800 w. Col Guard—Nov. 21, 1902. No. 52068 A.

The Allard Coal Separator (Separation der Kohlenach dem Verfahren von François Allard). Describing an improved form of jigging machine used in Belgium for separating coal from impurities by gravity. 1800 w. Glückauf—Nov. 29, 1902. No. 52455 D.

The Schüchtermann & Kremer and Humboldt Coal-Classifying Plant. Illustrated description of the coal-classifying and washing plant in use at the Grillo shaft of the Monopol Colliery, for dealing with 100 tons of coal per hour. 1400 w. Col Guard—Dec. 5, 1902. No. 52356 A.

Coal-Fields.

The Early Leicestershire Coal Field (1204-1832). Deals with the Cole Orton and Moira districts, giving a historical review. 3300 w. Col Guard—Nov. 21, 1902. Serial. 1st part. No. 52070 A.

Coal Formations.

The Mountain Formations of the Rhenish-Westphalen Coal District (Das Deckgebirge des Rheinisch-Westfälischen Carbons). H. Schulz-Briesen. A geological study of the mountains overlying the so-called Münster coal basin. 5000 w. 2 plates. Glückauf—Nov. 8, 1902. No. 52-453 D.

Coking.

Coking in Bee-Hive Ovens with Reference to Yield. Charles Catlett. Calls attention to the waste, the need of careful records, and what the records should show to determine where improvements are needed. 3800 w. Trans Am Inst of Min Engrs—Oct., 1902. No. 52281 D.

The Brunck System of By-Product Coke Ovens. Illustrates and describes the construction principles and operation of these ovens. 3000 w. Ir & Coal Trds Rev—Dec. 5, 1902. No. 52362 A.

Depreciation.

Depreciation as Affecting Collieries and Iron Works. H. A. Foster. Considers some of the usual methods of treating depreciation, and some that are less commonly considered. 3700 w. Ir & Coal Trds Rev—Nov. 21, 1902. No. 52081 A.

German Coke.

The German Coke Industry. Concerning the Rhenish-Westphalian Coke Syndicate and the price of blast furnace coke. 1400 w. Col Guard—Dec. 5, 1902. No. 52355 A.

Japan.

The Takasima Coal Mines, Japan. Abstract of a paper read by E. W. Nardin before the Australasian Inst. of Min. Engrs. Describes the mines and methods of working. 1100 w. Col Guard—Nov. 21, 1902. No. 52069 A.

Pulverized Coal.

See Mechanical Engineering, Steam Engineering.

Queensland.

Coal in the Cook District. C. F. V. Jackson. An account of the prospecting thus far, the deposits found, etc. Ill. 2000 w. Queensland Gov Min Jour—Oct. 15, 1902. No. 52172 B.

Scotland.

The Cost of Working Coal in Scotland. R. W. Dron. Discusses the increased cost of mining, the causes and the remedies. 2000 w. Ir & Coal Trds Rev—Dec. 5, 1902. No. 52358 A.

Waste.

The Waste in Working Coal in Great Britain. Walter S. Wardlaw. Prize essay. An illustrated article considering the two main systems of working coal, and the progress toward economy in waste in working. 1700 w. Ir & Coal Trds Rev—Dec. 5, 1902. No. 52357 A.

West Virginia.

Red Jacket Coal and Coke Co. Mines in Logan County, West Virginia. Frank A. Hill. An illustrated description of the coal, the mines and methods of handling. 2200 w. Mines & Min—Dec., 1902. No. 52195 C.

COPPER.

Mexico.

The Cananea Copper Deposits, Mexico. Walter Harvey Weed. An illustrated description of the district, the peculiarities of the ore, and matters of interest. 1700 w. Eng & Min Jour—Dec. 6, 1902. No. 52-239.

New Mexico.

The Burro Mountain Copper District,

We supply copies of these articles. See page 817.

New Mexico. George D. Reid. An illustrated account of this district and its ores. 1400 w. Eng & Min Jour—Dec. 13, 1902. No. 52342.

Peru.

A Great Copper District in Peru. Extract from an article in the London *Economist* giving an account of the Cerro de Pasco mines. 1600 w. Ir Age—Dec. 4, 1902. No. 52131.

See Electrical Engineering, Electro-Chemistry.

GOLD AND SILVER.

Amalgamation.

A Study of Amalgamation Methods, Especially the Patio Process, with the Object of Avoiding the Loss of Mercury. Miguel Bustamente, Jr. Describes the character of the ore to be treated and gives an account of the experimental investigations. 5400 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 52280 D.

Brazil.

The Gold-Field of the State of Minas Geraes, Brazil. Herbert Kilburn Scott. Information in regard to this field collected by the author during a five years' residence in the State. Illustrated descriptions of individual mines, methods of work, occurrence, etc. 9700 w. Trans Am Inst of Min Engrs—Feb. & May, 1902. No. 52282 D.

British Columbia.

Notes from the Atlin District, British Columbia. W. M. Brook. An illustrated article giving information of the progress made by the companies operating in this region. 2200 w. Eng & Min Jour—Nov. 29, 1902. No. 52110.

Camp Bird.

The Camp Bird Gold Mine and Mill. H. A. Titcomb. An illustrated description of this mine and mill in the San Juan region, in southwestern Colorado. 2500 w. School of Mines Quar—Nov., 1902. No. 52560 E.

Coeur d' Alenes.

The Mining Industry of Coeur d'Alenes, Idaho. J. R. Finlay. Illustrates and describes this silver-lead district, its geology and resources; the veins and ore deposits; methods of operation, etc. Map. 6500 w. Trans Am Inst of Min Engrs—Feb. & May, 1902. No. 52278 D.

Concentration.

Development of Coarse Concentration in the Slocan District. Samuel S. Fowler. From the Canadian Min Inst. Considers what has been done toward working these deposits economically. 5500 w. B C Min Rec—Dec., 1902. No. 52388 B.

Cyanide Process.

Cyaniding Concentrates by Percolation at Choukpazat. C. M. Wright. Paper before the Institute of Mining and Metallurgy, London, on the treatment of gold ore concentrates consisting of 30 to 40 per cent. sulphides and 60 to 70 per cent. coarse sands, in Burma. 1000 w. Eng & Min Jour—Dec. 20, 1902. No. 52595.

Cyaniding Silver Ores. R. Stuart Browne. An account of some of the work which is being done in Nevada, in applying the cyanide process to the treatment of silver ores. 1400 w. Min & Sci Pr—Dec. 13, 1902. No. 52597.

The Filter Press Process of Cyanidation of Slimes. E. Barton Hack. Describes this method of treatment, stating its advantages. Ill. 1500 w. Min Rept—Dec. 11, 1902. No. 52386.

The Treatment of Cupriferous Gold Ores by Cyanide of Potassium. Louis Janin, Jr. A description of several processes for treating gold ores containing copper, and particularly of Bertram Hunt's method of leaching with an ammoniacal cyanide solution. 2000 w. Eng & Min Jour—Dec. 20, 1902. No. 52594.

Dredges.

Gold Dredges—Their Construction and Manipulation. David K. Blair. Read before the N. S. W. Chamber of Mines. A description of the "Bucket Gold Dredge," the general principles of construction and manipulation, the accidents liable, with their cause, effect and remedy. 9000 w. Can Min Rev—Nov. 30, 1902. Serial. 1st part. No 52105 B.

Guiana.

Gold in Venezuelan Guiana (L'Or en Guyane Vénézuélienne). Norbert Paquet. A geological study of Venezuelan Guiana with reference to the gold deposits and present methods of working, with map. 12000 w. .1 plate. Rev Univ des Mines—Nov., 1902. No. 52445 G.

Hydraulic Mining.

Low-Grade Gravel Property. Illustrated description of a property in California, where the supply of water is brought 30 miles, and the expense of maintenance is rather high. Gives results showing profits. 1300 w. Min & Sci Pr—Dec. 6, 1902. No. 52387.

The Hydraulic Installation at the Panuco Mines in Mexico. Horace L. Short. Abstract of a paper read before the Inst. of Min & Met., London. Description of the water-power system of this gold and silver mining property. 2000 w. Eng & Min Jour—Dec. 6, 1902. No. 52241.

La Plata.

The La Plata Mountains. Prof. Arthur Lakes. Observations on their formations

and the influence of the different igneous rocks upon mineralization. Ill. 2300 w. Mines & Min—Dec., 1902. No. 52203 C.

"Marauding."

"Marauding" in French Guiana. David Levat. The term indicates a prospector or placer miner who practices his industry on any gold-bearing territory regardless of the legal proprietor, and is not locally considered at all disgraceful. 1800 w. Eng & Min Jour—Dec. 13, 1902. No. 52344.

Mechanical Feeding.

Mechanical Feeding of Silver-Lead Blast Furnaces. Arthur S. Dwight. Considers the present state of the art and describes devices which have come under the personal observation of the writer, recording his results in the practical working of one of the systems. Ill. 12800 w. Trans Am Inst of Min Engrs—Nov., 1902. No. 52277 D.

Mexico.

The Prieta Mine of Parral, Mexico. S. M. Terry. Gives the history of this noted silver mine and an account of its reopening after being flooded for many years. Ill. 1200 w. Eng & Min Jour—Dec. 6, 1902. No. 52238.

Smelter.

The New Bully Hill Smelter. Illustration, with description of the works, in California, the deposits, etc. The ores carry copper, gold and silver. 1700 w. Eng & Min Jour—Dec. 6, 1902. No. 52240.

Sulphide Ores.

A Dry Process for the Treatment of Complex Sulphide Ores. H. L. Sulman and H. K. Picard. A paper read before the Inst. of Mining and Metallurgy, London, describing a process for treating ores in which are zinc blende and galena, as well as silver. Present practice in Australia is reviewed. 5400 w. Can Min Rev—Nov. 30, 1902. No. 52104 B.

IRON AND STEEL.

Brazil.

The Iron Ores of Brazil. Herbert Kilburn Scott. Abstract of a paper read before the Inst of Min. & Met., London. Information concerning very large deposits of fine quality. 1300 w. Eng & Min Jour—Dec. 6, 1902. No. 52242.

Briquetting.

Briquetting Iron Blue Dust. R. M. Hale. Describes the methods employed in the manufacture of briquettes, discussing important points, and conclusions from actual operation. 3500 w. Ir Age—Dec. 11, 1902. No. 52257.

Electric Driving.

See Electrical Engineering, Power Applications.

Electric Smelting.

See Electrical Engineering, Electro-Chemistry.

Gas Engines.

See Mechanical Engineering, Special Motors.

Great Britain.

The Iron and Steel Industries of Great Britain—Their Conditions and Outlook. J. Stephen Jeans. Abstract of a lecture before the students of Birmingham University. Considers the conditions upon which success depends, and how far these are met. 3000 w. Ir & Coal Trds Rev—Dec. 5, 1902. No. 52361 A.

Ingots.

Chemical Composition of Steel Ingots. Alex. Wahlburg. Discusses the objects of piping and blow-holes in ingots and their causes and prevention, giving a digest of Brinell's work, with which the writer agrees. 4600 w. Am Mfr—Nov. 27, 1902. Serial. 1st part. No. 52098.

Iron Ores.

A Comparison of the Origin and Development of the Iron Ores of the Mesaba and Gogebic Iron Ranges. Kenneth Leith. Abstract of a paper presented to the Lake Superior Min. Inst. Outlines and compares certain conclusions reached by the U. S. Geol. Survey. 2700 w. Ir Age—Dec. 4, 1902. No. 52133.

Rolling.

The Laws of the Rolling of Iron (Lois du Laminage du Fer). R. Tonkow. A study of the relation of the diameter and speed of rolls to the extent of reduction of the metal at each pass. 8000 w. Rev Univ des Mines—Oct., 1902. No. 52444 G.

Slag.

The Composition of Blast Furnace Slag (Ueber die Constitution er Hochofenschlacke). Karl Zulkowski. A review of the theory of Jüptner, with formulas indicating the reactions involved in the formation of furnace slag. Two articles, 4000 w. Oesterr Zeitschr f Berg u Hüttenwesen—Dec. 6, 1902. No. 52460 each D.

Valves.

Water Controlled Forter Reversing Valve. Illustrated description of a new style of gas valve for regenerative furnaces. 1600 w. Ir Age—Dec. 18, 1902. No. 52393.

MINING.

Anemometers.

The Anemometer Testing Station of the Westphalian Mining Bureau at Bochum (Die Anemometer-Prüfungstation der Westfälischen Berggewerkschaftskasse in Bochum). H. Stach. With details of the construction and use of the whirling ap-

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paratus for testing the anemometers used in measuring ventilating current in mines. 2000 w. 1 plate. Glückauf—Nov. 22, 1902. No. 52454 D.

Bench Method.

Mining on the Bench Method of Working Adapted to Peculiar Conditions in the Clinch Valley Field of Southwestern Virginia. Charles Colcock Jones. Describes the conditions and the methods of working. 1000 w. Mines & Min—Dec., 1902. No. 52200 C.

Colorado.

The Soils of Colorado. Prof. Arthur Lakes. Considers their nature in relation to their geological origin and surroundings, and their availability for irrigation. 3200 w. Mines & Min—Dec., 1902. No. 52198 C.

Development.

Our Mining Interests. Prof. J. A. Holmes. Read before the International Mining Congress. Discusses some of the factors contributing to and influencing American mining development. 3700 w. Mines & Min—Dec., 1902. Serial. 1st part. No. 52202 C.

Drilling.

Method of Drilling and Shutting Off Water in Experimental Boreholes. Bergassessor Jacob, in *Glückauf*. Describes a method adopted to meet unusual conditions, which, with some alterations, is capable of being adapted to the boring to faults in the vicinity of old workings, etc. Ill. 1300 w. Col Guard—Nov. 28, 1902. No. 52194 A.

Earth Movements.

Recent Earth Movements. Prof. Arthur Lakes. An account of some movements in the Rocky Mts. as shown by effects on streams and mines. 1500 w. Mines & Min—Dec., 1902. No. 52204 C.

Electric Power.

See Elec. Engng., Power Applications.

Fans.

On Experiments with Duplicate Ventilating Fans at Bamfurlong Collieries. J. W. Hutchinson. Read before the Manchester Geol. Soc. A statement of conditions to be met, and an account of experiments made, illustrations of the present arrangement of engines and fans, with table of tests and measurements made. 1800 w. Ir & Coal Trds Rev—Nov. 28, 1902. No. 52250 A.

Head Frame.

An Eldorado County, Cal., Head Frame. C. H. Wildman. An illustrated description of a new head frame recently erected on the Flagstaff shaft of the Mt. Hope mine. 700 w. Min & Sci Pr—Nov. 29, 1902. No. 52212.

Hoisting.

Hoisting from Great Depths. Hennen Jennings. Abstracted from paper read before the So. African Assn. of Engrs. Describes the Witwatersrand gold-fields and the conditions to be met by winding plants, discussing the most advantageous method. 3000 w. Eng & Min Jour—Nov. 29, 1902. No. 52111.

Winding and Winding Appliances. Daniel Davies. Considers the varieties of winding engines, and their control, winding ropes, etc. 2200 w. Ir & Coal Trds Rev—Dec. 5, 1902. No. 52359 A.

Methods.

Mining Methods and Appliances. The first of a series of articles aiming to give information helpful to candidates for mine manager's examinations. Ill. 1100 w. Aust Min Stand—Nov. 6, 1902. Serial. 1st part. No. 52374 B.

Mexico.

The Mineral Zone of Santa Maria del Rio, San Luis Potosi. Jesus P. Menzano. Summary of a report made in 1890 for the Companie Investigadora Mexican y Americana. Gives the geology, mineral deposits, describing the ores found, etc. Silver, mercury, bismuth, iron, tin, etc., are found, but not all in payable quantities for mining. 2200 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 52-283 D.

Milling Plant.

The Pride of the West M. & M. Co., Washington, Ariz. Jesse Scobey. An illustrated description of a milling plant and process where a complex ore, producing zinc, lead and copper, is treated in one milling operation that comprises dry crushing, roasting, magnetic separation, wet concentration, drying and smelting. 2200 w. Min & Sci Pr—Dec. 13, 1902. No. 52599.

Mining Management.

The General Management of Metalliferous Mines. Albert Williams, Jr. A discussion of the fundamental business principles upon which successful mining management depends. 2500 w. Engineering Magazine—January, 1903. No. 52488B.

Muffle Furnace.

A Wood-Burning Muffle Furnace. Louis Janin, Jr. Illustrated description of a large superimposed double muffle furnace for assaying, erected in Ely, Nevada. 600 w. Eng & Min Jour—Dec. 20, 1902. No. 52591.

Quarrying.

Improvements in the Methods of Quarrying Slate. Translated from *La Nature*. Describes the old methods and the new. Ill. 1300 w. Sci Am Sup—Dec. 6, 1902. No. 52220.

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Shaft-Sinking.

The Sinking of Shafts in Water-Bearing Strata (Creusement de Puits à Niveau Plein). Marcel Tock. A detailed account of the sinking of two shafts in water-bearing strata at Quesnoy, Bois du Luc, Belgium. The Kind-Chandron process was employed. 8000 w. 6 plates. Rev Univ des Mines—Oct., 1902. No. 52443 G.

Smelter.

The New Smelter at Salida, Colorado. Etienne A. Ritter. An illustrated description of a large smelting works for treating lead and copper and other ores. 800 w. Eng & Min Jour—Dec. 20, 1902. No. 52592.

Smelting.

Use of Crude Oil in Smelting. A. von der Ropp. Read before the California Miners' Assn. A discussion of the practical side of the subject. 2300 w. Min & Sci Pr—Nov. 29, 1902. No. 52211.

Surveying.

The Evolution of Mine-Surveying Instruments. Continued discussion of the paper of Dunbar D. Scott, read at the Buffalo meeting, Oct., 1898. 1000 w. Trans Am Inst of Min Engrs—Nov., 1902. No. 52284 D.

Tamps.

Notes on Recent Experiments with Mechanical Tamps. W. R. Crane. An illustrated description of successful experiments in blasting, in which were used mechanical tamps consisting of a standard and two cylindrical wedges with serrated faces. 2500 w. Eng & Min Jour—Dec. 20, 1902. No. 52593.

Timbering.

Mine Timbering by the Square Set System at Rossland, B. C. A discussion of a previous article by Bernard MacDonald, by Ernest Woakes, at a meeting of the Canadian Mining Institute, and Mr. MacDonald's rejoinder. The conditions in a gold mine in Darien, Colombia, are described. 1800 w. Min & Sci Pr—Dec. 13, 1902. No. 52596.

Systematic Timbering in French Mines. Particulars from a report issued by a subcommittee of the Prussian Commission on the Falls of Rock and Coal in Mines, concerning the methods of working and timbering employed in French collieries. Ill. 900 w. Col Guard—Nov. 28, 1902. Serial. 1st part. No. 52193 A.

Valuation.

The Valuation of Mines of Definite Average Income. H. D. Hoskold. Suggests a method of valuing mines, pointing out certain financial features. 4000 w. Trans Am Inst of Min Engrs—Oct., 1902. No. 52285 D.

Washington.

Ore Deposits of Monte Cristo, Washington. An abstract monograph, by J. E. Spurr, published by the U. S. Geol. Survey. Ill. 2500 w. Mines & Min—Dec., 1902. No. 52197 C.

MISCELLANY.

Africa.

The Distribution of Mineral Wealth in Africa (La Repartition et les Caractères de la Richesse Minérale en Afrique). L. De Launay. A general study of the mineral resources of Africa, with maps showing the distribution and possibilities of development. 6000 w. Rev Gen des Sciences—Nov. 30, 1902. No. 52436 D.

Asphalt.

The Asphalt Deposits of Pike County, Arkansas. C. W. Hayes. Describes those deposits which have been recently developed. 1500 w. Eng & Min Jour—Dec. 13, 1902. No. 52343.

Manganese.

The Manganese Industry of the Department of Panama, Republic of Colombia. E. G. Williams. Gives a general description of the region, the topography, deposits, character of the ore, the mines worked, etc. 11800 w. Trans Am Inst of Min Engrs—Nov., 1902. No. 52279 D.

Ores.

The Genesis of Ore-Deposits. J. Malcolm Maclaren. From the *Mining Journal*, London. An outline of the modern theory of ore deposition, as given in recent papers by American and German geologists. 5300 w. N Z Mines Rec—Nov. 17, 1902. No. 52610 B.

Petroleum.

American Petroleum Possibilities. George Ethelbert Walsh. An illustrated review of the oil regions of the United States and their productive capacity, with a forecast of their future, and a discussion of the growing importance of petroleum as fuel. 2000 w. Cassier's Mag—Dec., 1902. No. 52548 B.

Shale.

Shale Mine at La Harpe, Kansas. W. R. Crane. An illustrated article describing an instance of underground mining for brick making material. 2500 w. Mines & Min—Dec., 1902. No. 52201 C.

Titanium.

The Metallurgy of Titanium. Auguste J. Rossi. On methods of treatment of these ores and the alloys formed with them. 7200 w. Trans Am Inst of Min Engrs—Feb. & May, 1902. No. 52286 D.

Zinc.

Notes on the Magnetic Separation of Zinc-Iron Sulphides, with Observations on Preparatory Wet Concentration. Guy H. Elmore. Describes the treatment of lead-zinc-iron ores and the workings of the magnetic separator. Ill. 4000 w. Min Rept—Dec. 18, 1902. No. 52615.

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RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION.

Discipline.

Efficient Discipline. Papers by C. H. Ketcham, W. W. Wheatly, G. W. Sengerland, and Thomas E. Mitten, discussing this subject from different points of view, with a general discussion following. 19000 w. N Y R R Club—Nov. 21, 1902. No. 52335.

MOTIVE POWER AND EQUIPMENT.

Brakes.

Air Brakes. Illustrates and describes the air-brake apparatus, and principles of operation. 1700 w. Sci Am—Dec. 13, 1902. No. 52327.

Air Brake Testing Department of the Armour Car Lines. Illustrated description of the triple valve testing department, giving rules governing the cleaning and repairs of air brakes on the Armour car lines. 1000 w. Ry Mas Mech—Dec., 1902. No. 52205.

Automatic Outside Brake for Trains. A brief technical description of an interesting apparatus which has been tested at a speed of 62 miles an hour. Ill. 1200 w. U S Cons Repts, No. 1516—Dec. 10, 1902. No. 52235 D.

Cars.

The Latest Type of Passenger Cars in Great Britain. Brief illustrated description of cars built for the East Coast route between England and Scotland. 800 w. Ry Age—Dec. 5, 1902. No. 52209.

Two New Vanderbilt Cars. Illustrates and describes new designs for structural steel cars of 80,000 lbs. capacity. 500 w. Am Engr & R R Jour—Dec., 1902. No. 52115 C.

Coal Weighing.

The Time Element in Coal Consumption. Editorial discussion of the advantages of weighing coal instead of measuring it. 900 w. Loc Engng—Dec., 1902. No. 52226 C.

Locomotive Practice.

Modern Locomotive Practice. C. E. Wolff. Discusses the compound principle and how the special conditions under which a locomotive works affects the question. Ill. 2000 w. Mech Engr—Nov. 29, 1902. No. 52255 A.

Locomotives.

American "Prairie" Type Locomotives. Arthur E. Kyffin. An illustrated article discussing the special features of this class of engine. 2000 w. Prac Engr—Nov. 21, 1902. Serial. 1st part. No. 52062 A.

A Ride to Chicago and Back on the Locomotive of the Twentieth Century Limited. An interesting account of the trip, with illustrations. 2500 w. Sci Am—Dec. 13, 1902. No. 52320.

Atlantic Type Passenger Locomotive—Vandalia Line. Illustration, cross sections, rear and side elevations, with general dimensions. 5000 w. Ry Mas Mech—Dec., 1902. No. 52206.

Consolidation Engines for the Norwegian State Railway. Illustration and description of engines for service on heavy gradients. 1100 w. Engr, Lond—Nov. 28, 1902. No. 52180 A.

Consolidation Locomotive for the Baltimore and Ohio. Illustrations and general description. 400 w. R R Gaz—Dec. 5, 1902. No. 52224.

Engine No. 3—Wrexham, Mold, and Connah's Quay Railway. A rather unusual design with interesting features.. Illustrations and dimensions. 400 w. Engr, Lond—Nov. 21, 1902. No. 52080 A.

Fast Engines of the Atlantic Type for the Central Railroad of New Jersey. Illustrated detailed description. 800 w. Loc Engng—Dec., 1902. No. 52156 C.

Locomotive Types of Great Britain. J. F. Gairns. An illustrated review of all the types of British locomotives at present in use, old as well as new. 3000 w. Cassier's Mag—Dec., 1902. No. 52549 B.

Notes on the History of the American Locomotive. Herbert T. Walker. Reviews the history from 1802-3 of railroad engines, tracing in outline the development. Ill. 2500 w. Sci Am—Dec. 13, 1902. No. 52321.

Self Cleaning Locomotive Front Ends. Frank Slater. Diagrams and discussion of various types, with general discussion by members. 7800 w. W Ry Club—Nov. 18, 1902. No. 52337 C.

Some Features of British and American Express Locomotives. Paul T. Warner. Points out some of the general features in the design of the express passenger engines of the two countries. 2300 w. R R Gaz—Dec. 19, 1902. No. 52508.

The Compound Locomotive and Its Development in France. A. Herdner. An interesting review of types and advantages of each and the work for which each is suited, with discussion of their development in other countries and in France. Ill. 4500 w. Am Engr & R R Jour—Dec., 1902. Serial. 1st part. No. 52116 C.

We supply copies of these articles. See page 817.

Two-Cylinder Compound Locomotives. Illustrated description and dimensions of the most recent development of the two-cylinder compound for passenger service. It has a double-ported valve for the low-pressure cylinder. For use on the Canadian Pacific Ry. 3500 w. Am Engr & R R Jour—Dec., 1902. No. 52114 C.

Locomotive Tests.

Railway School Locomotive Tests. An illustrated description of the locomotive tests conducted each fall by the Railway School of Sibley College, Cornell, on the Delaware, Lackawanna and Western Railroad. 1200 w. Sibley Jour Mech Engng—Dec., 1902. No. 52585 C.

Lubrication.

Locomotive Lubrication. A very practical discussion on valves, cylinders and journals as well as lubricating oils, and their use, with illustrations. 6500 w. Pro Rocky Mountain Ry Club—Nov., 1902. No. 52537 D.

Piston Valves.

The Use of Piston Valves on Four-Cylinder Compound Locomotives (L'Emploi de Liroirs Cylindriques sur les Locomotives Compound à Quatre Cylinders). L. C. M. Pelletier. Data and results of the experience of the Eastern Railway of France, with details of construction of recent locomotives. 8000 w. 3 plates. Mem Soc Ing Civ de France—Sept., 1902. No. 52457 G.

NEW PROJECTS.

Africa.

Railways in Africa (Die Eisenbahnen quer durch Afrika). Dr. Franz Ritter v. LeMonnier. A general discussion of transport in Africa with a review of existing and proposed railways. Two articles. 12,000 w. Zeitschr d Oesterr Ing u Arch Ver—Nov. 14, 21, 1902. No. 52416 each B.

The Uganda Railway. The present article describes Mombasso, and the conditions found there; also Kilindini Station, Mazeras, and other stations, the country and some of the railway works. Ill. 2500 w. Engr, Lond—Nov. 21, 1902. Serial. 1st part. 52078 A.

British Railways.

The Railways in Parliament. Editorial review of the bills before the British parliament and the improvements proposed. 3000 w. Engng—Nov. 28, 1902. No. 52191 A.

Cuba.

The New Railroad System in Cuba. Illustrated description of the recently completed line between Santiago, on the east, and Santa Clara, in the centre of the island, with a through connection to Havana. 1600 w. R R Gaz—Nov. 28, 1902. No. 52040.

Cut-Off.

Construction Work on the Southern Pacific Cut-Off Across the Great Salt Lake, Utah. C. W. Arthur. An account of this interesting work, the diffiuclties met in the construction, etc. Ill. 1500 w. Eng News—Nov. 27, 1902. No. 52030.

Japan.

Progress of Japanese Railway Enterprise. Reviews briefly Japanese railway affairs. 1000 w. U S Cons Repts, No. 1512—Dec. 5, 1902. No. 52139 D.

Long Island R. R.

Methods of Work on the Atlantic Avenue Improvement of the Long Island R. R. Illustrated description of the subway and viaduct construction for removal of tracks from the surface of the street. 2200 w. Eng News—Dec. 18, 1902. No. 52512.

PERMANENT WAY AND FIXTURES.

Coaling Station.

Locomotive Coaling Station of the Wisconsin Central Ry. at Fond-du-Lac, Wisconsin. An illustrated description of a large coal storage and coal handling plant for supplying locomotives. 1100 w. Eng News—Nov. 27, 1902. No. 52029.

Floods.

See Civil Engineering, Rivers and Harbors.

France.

Some Notes on the Paris, Lyons and Mediterranean Railroad. General description, some of the locomotives and their performances, etc. 2200 w. R R Gaz—Dec. 12, 1902. No. 52353.

Grade Crossings.

The Abolition of Grade Crossings in Massachusetts. Edmund K. Turner. A report of what has been done in this state, legislation, and the course which has been pursued. Also general discussion. 15000 w. Jour Assn of Engng Soc's—Nov., 1902. No. 52507 C.

Joints.

The Chief Causes of Instability in Railway and Tramway Line Joints. A. Roberto Pullen. Discusses the difficulties due to joints in rails, and whether the joints are really objectionable, suggesting the adoption of some means of absolutely locking nuts on all lines. 1300 w. Tram & Ry Wld—Nov. 13, 1902. No. 52130 B.

Passenger Stations.

New Passenger Station of the D. L. & W., at Binghamton, N. Y. Illustrations, sections and plans with brief description. 500 w. Ry & Engng Rev—Dec. 6, 1902. No. 52261.

The New Passenger Stations in Dresden (Die Neuen Personenbahnhöfe in

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Dresden). Josef Unger. With numerous illustrations of the new stations in Dresden, and plans of the buildings, track yards and connections. 2500 w. 4 plates. Zeitschr d Oesterr Ing u Arch Ver—Dec. 5, 1902. No. 52418 B.

The New York Central Terminal. Editorial on the plan for the improvement of the Grand Central Station in New York city. 1200 w. R R Gaz—Dec. 12, 1902. No. 52354.

Shops.

New Locomotive Repair Shops of the Philadelphia and Reading. Illustrated description of the shops and their equipment. 5200 w. R R Gaz—Dec. 12, 1902. No. 52352.

The Union Pacific Shops. Illustrated detailed description of the new shop plant at Omaha, Neb., which is rapidly occupying the site of the old shops. 4800 w. Ry Age—Dec. 12, 1902. No. 52389.

Signalling.

A New Railway Block Signal System. An illustrated detailed description of the Miller block signals which have just been placed in the Park avenue tunnel, New York. They are automatic and given directly in the engine cab. 4800 w. Eng News—Dec. 18, 1902. No. 52515.

The "Crewe" System of Electric Railway Signalling. Illustrated description of the system of working points and signals at this station on the London & North-Western Ry. 900 w. Engr, Lond—Dec. 5, 1902. No. 52369 A.

The "Crewe" System of Railway Signalling. Illustrated description of an electric system. 4800 w. Elec Rev, Lond—Nov. 28, 1902. No. 52182 A.

Railroad Signals. B. B. Adams. Illustrated description of block and interlocking signals. 2200 w. Sci Am—Dec. 13, 1902. No. 52323.

TRAFFIC.

Per Diem.

Per Diem as a Standard of Measurement and Per Diem Rules as Practically Applied at St. Louis Terminals. W. M. Prall. Gives deductions from the applications of the per diem rules in the St. Louis and East St. Louis terminals. General discussion follows. 12000 w. St. Louis Ry Club—Nov. 14, 1902. No. 52083.

Rate-Making.

Rate-Making and its Causes. C. L. Wellington. A general discussion of the difficulties in making railroad tariffs and the influences which determine them. 1500 w. Pro Rocky Mountain Ry Club—Nov., 1902. No. 52538 D.

MISCELLANY.

Government Railroads.

Railroad Building as a Mode of Warfare. John McAuley Palmer. Considers the civilizing effect of railroads, as an argument for urging a system of insular railways in the Philippines. 3200 w. N Am Rev—Dec., 1902. No. 52093 D.

Methods.

British and American Railroad Methods. Extract from a letter of an American mechanical engineer giving opinions, wherein British methods could be improved. 900 w. R R Gaz—Dec. 5, 1902. No. 52223.

Oldest Railroad.

The Oldest Railroad Company in the World. W. B. Paley. An account of the Plymouth and Dartmouth Railway, England, incorporated on July 2, 1819. 1600 w. R R Gaz—Dec. 19, 1902. No. 52510.

United States.

The Railroad System of the United States. An illustrated article showing the magnitude of the properties and operations. 1700 w. Sci Am—Dec. 13, 1902. No. 52322.

STREET AND ELECTRIC RAILWAYS

Australia.

The Electric Railway in Sydney. An illustrated detailed description of the largest and most complete electric railway system in Australia. 3300 w. St. Ry Jour—Dec. 6, 1902. No. 52234 D.

Benefit Association.

The Brooklyn Rapid Transit Employees' Benefit Association. Some interesting features concerning its organization and methods of work. Ill. 2300 w. St Ry Jour—Dec. 13, 1902. No. 52307 D.

Brakes.

Pneumatic Brake Trials. An account of tests made of the Hewitt and Rhodes pneumatic slipper brake. 900 w. Elec Rev., Lond—Nov. 21, 1902. No. 52067 A.

Earths.

The Indication of Earths on Trolley Standards. Discusses faults on a trolley and the earth lamp system of indicating, and criticizing some devices on the market. 1500 w. Elec Rev, Lond—Nov. 28, 1902. No. 52180 A.

Electric Branch.

The Concord & Manchester Branch of the Boston & Maine Railroad. An illustrated description of an electric branch

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road built and operated by a steam railroad company. 2500 w. St Ry Jour—Dec. 6, 1902. No. 52233 D.

Electric Locomotive.

Electric Traction. Illustrated brief description of the 10,000-volt alternating-current locomotive for the Berlin-Zossen experiments. 1000 w. Sci Am—Dec. 13, 1902. No. 52325.

The Siemens & Halske High Speed Electric Locomotive (Schnellbahn-Lokomotive von Siemens & Halske A. G.) A detailed description of the electric locomotive built by Siemens & Halske for the high speed trials on the Marienfeld-Zossen line. 2500 w. 1 plate. Zeitschr d Ver Deutscher Ing—Nov. 15, 1902. No. 52-403 D.

Electric Railways.

The Western Ohio Railway. D. W. Pell. Illustrated detailed description of a high-speed electric line operating at present 47 miles of road, and having 67.5 miles more under construction. 2000 w. Ry Age—Dec. 5, 1902. No. 52208.

Electric Traction.

Electricity as a Motive Power on Trunk Lines. Cornelius Vanderbilt. Considers, in a general way, the reasons pro and con, drawing conclusions from an examination of the principles involved. 3000 w. N Am Rev—Dec., 1902. No. 52090 D.

Freight Handling.

An Important Freight-Handling Road. An illustrated description of the methods adopted by the Toledo and Western Railway, an interurban line operating 68 miles of road. 2000 w. St Ry Jour—Nov. 29, 1902. No. 52101 D.

Interurban.

Collisions on Interurban Roads. Considers the causes of the accidents, and means of signalling employed. 1700 w. St Ry Jour—Dec. 6, 1902. No. 52232 D.

The Nogentais System, Paris, France. C. L. Durand. An illustrated description of an interurban traction system. 1600 w. Elec Rev, N Y—Dec. 13, 1902. No. 52332.

The Worcester & Southbridge Street Railway. An illustrated detailed description of this interurban line in Massachusetts, and its equipment. 4200 w. St Ry Jour—Dec. 6, 1902. No. 52227 D.

London Underground.

Deep-Tunnel Railways. Editorial discussing these London railways, especially the schemes associated with the name of Mr. Yerkes. 3000 w. Engng—Nov. 28, 1902. No. 52190 A.

London Underground Railways. A review of the London electric railway bills which will come before Parliament in 1903, with map. 1200 w. Elect'n, Lond—Dec. 12, 1902. No. 52529 A.

The Tangle of London Locomotion. Sidney Low. A discussion of the transit problem in London, the tube, or deep-level railways; the high-level, or sub-surface tunnels, etc.; the points the Special Commission should consider. 8500 w. Nineteenth Cent—Dec., 1902. No. 52371 D.

Underground Electric Tube Railways in London. A. Webster. Some gossip concerning old and new schemes, with sketch maps. 2400 w. Elec Rev, N Y—Dec. 20, 1902. No. 52527.

Long Distance.

Electric Traction on Long Distance Railways. Alton D. Adams. Reviews what has been done in Europe and America to solve this problem. 2000 w. Sci Am—Dec. 13, 1902. No. 52326.

Mono-Rail.

An Experimental Mono-Rail Line. Day Allen Willey. Brief illustrated description of a railway on the mono-rail system which has been in operation for experimental purposes near Baltimore. 700 w. Sci Am—Dec. 6, 1902. No. 52219.

The First Suspended Mountain Railway in the World (Die Erste Bergschwebebahn der Welt). E. A. Ziffer. A description of the suspended railway of the Langen type from Loschwitz to the heights of Lochwitz above Dresden. 2000 w. Mitt des Ver f die Ford d Local und Strassenbahnwesens—Nov., 1902. No. 52483 D.

The Manchester and Liverpool Electric Express Railway. Illustrated description of a proposed railway on the monorail system, to be operated at high speed by electricity. 5400 w. Tram & Ry Wld—Nov 13, 1902. No. 52125 B.

New Jersey.

The Electric Railroads in New Jersey. E. Bjerregaard. Map and account of the electric railroads of the state, especially those connecting New York and Philadelphia. Ill. 6500 w. R R Gaz—Nov. 28, 1902. No. 52039.

New York.

New York and Brooklyn Rapid Transit Subway. An illustrated article giving an idea of the location of the subway at the Battery and under the East River, and describing some of its features. This section is now under construction. 1400 w. Sci Am—Dec. 20, 1902. No. 52395.

New York Rapid Transit Railroad. Editorial review of the report of the Board of Rapid Transit Railroad Commissioners. 1800 w. Eng Rec—Nov. 29, 1902. No. 52117.

The Manhattan-Brooklyn Branch of the Rapid Transit Subway. Drawings showing interesting details of construction, with descriptive notes. 1200 w. Sci Am Sup—Dec. 20, 1902. No. 52399.

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Overhead.

Some Notes on Overhead Tramway Wires. Lionel E. Harvey. Discusses the construction, inspection and use of the line. 1100 w. Elec Rev, Lond—Nov. 28, 1902. No. 52181 A.

Pay Department.

Pay Department of the Metropolitan Company's Construction Department. Describes the method in use in paying laborers where a large number are foreigners unable to speak English. 1200 w. St Ry Jour—Nov. 29, 1902. No. 52102 D.

Power House.

Some Features of the New York Rapid Transit Power House. Illustrations with brief description of interesting features. 1800 w. Power—Dec., 1902. No. 52266 C.

Repair Shops.

New Repair Shops of the Brooklyn Rapid Transit Company. Brief illustrated description of plans for convenient and extensive shops. 1000 w. St Ry Jour—Dec. 13, 1902. No. 52308 D.

Rolling Stock.

The Rolling Stock of the Manhattan Railway Company. Full particulars, illustrations and working drawings of the cars and trucks of the new electric equipment. 3500 w. St Ry Jour—Dec. 6, 1902. No. 52230 D.

Single Phase Ry.

Single Phase Railways. Discussion of paper by B. G. Lamme entitled "Washington, Baltimore and Annapolis Single Phase Railways." 10,000 w. Trans Am Inst of Elec Engrs—Nov, 1902. No. 52-289 D.

Snow.

Equipment and Organization for Properly Handling Snow Storms. J. F. Conway. Read at meeting of New England St. Ry. Club. Suggestions and directions. 4000 w. St Ry Jour—Nov. 29, 1902. No. 52103 D.

Stray Currents.

Electrolysis and Its Ravages. William Brophy. From a paper read before the International Assn. of Fire Engrs. Advises the placing of insulators or circuit breakers in metal pipes to prevent any flow of current over them. 2400 w. Fire & Water—Dec. 13, 1902. No. 52305.

Escaping Electricity and the Law. W. Valentine Ball. A review, from a British standpoint, of the legal aspects of the question of stray currents, and the liability for damages due to their electrolytic action and their interference with telegraph signals. 2500 w. Trac and Trans—Dec., 1902. No. 52562 E.

Surface-Contact.

Surface-Contact Systems. Abstract of a paper by G. Paul, of Nuremberg. A criticism of some of the systems. 1400 w. Engng—Nov. 21, 1902. No. 52073 A.

Third Rail.

The Sleet Break-Down of the Manhattan System. An article showing that the recent difficulties in running trains on the New York Elevated Ry. are not inherent in the third rail system, and giving illustrations of pneumatic sleet cleaner and contact shoe and hanger. 800 w. Elec Wld & Engr—Dec. 20, 1902. No. 52518.

Third Rail Electric Traction in Italy. Illustrated description of interesting features of the line between Porto Ceresis and Milan, especially the steam plain. 1500 w. St Ry Jour—Dec. 6, 1902. No. 52228 D.

Traction Engines.

Tramway Traction Engines for Glasgow. Drawing and descriptive notes of the 800 h. p. engines which have done admirable service in connection with these tramways. 600 w. Engr, Lond—Dec. 5, 1902. No. 52368 A.

Tramways.

Electric Tramways. C. Hopkinson, B. Hopkinson and E. Talbot. Read before the Brit. Inst. of Civ. Engrs. Abstract. Considers briefly the generation of power, transmission of power to the cars, rolling stock, and earth returns. 1700 w. Mech Engr—Nov. 22, 1902. No. 52059 A.

Transfers.

Some Disputed Points Concerning Transfers. Arthur Wentworth. A discussion of the views of C. D. Meneely as given in a recent paper. 2500 w. St Ry Jour—Dec. 6, 1902. No. 52231 D.

Tyneside.

Electric Traction on Tyneside. Illustrated description of the line and its equipment. 3000 w. Tram & Ry Wld—Nov. 13, 1902. No. 52126 B.

Rail Welding.

Expansion and Contraction of Welded Tramway Rails. C. V. Boys. An explanation of the action that takes place. 1100 w. Tram & Ry Wld—Nov. 13, 1902. No. 52128 B.

Thermit Welding for Tram Rails. C. E. Masterman. Describes the thermit process and how it is carried out in practice. Ill. 1900 w. Tram & Ry Wld—Nov. 13, 1902. No. 52127 B.

Wheels.

Street Railway Wheels in Europe. Illustrated descriptions of wheels used and facts relating to their wear, cost, etc. 2200 w. St Ry Jour—Dec. 6, 1902. No. 52229 D.

EXPLANATORY NOTE—THE ENGINEERING INDEX.

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THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED.

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the Index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* Boston.
American Electrician. *m.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Gas Light Journal. *w.* New York.
American Jl. of Science. *m.* New Haven, U.S.A.
American Machinist. *w.* New York.
Am. Manuf. and Iron World. *w.* Pittsburg, U. S. A.
American Shipbuilder. *w.* New York.
American Telephone Journal. *w.* New York.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. d Ing. e d Arch. Ital. *w.* Rome.
Architect. *w.* London.
Architectural Record. *qr.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Sydney.
Autocar. *w.* Coventry, England.
Automobile. *m.* New York.
Automobile Magazine. *m.* New York.
Automotor & Horseless Vehicle Jl. *m.* London.
Brick Builder. *m.* Boston.
British Architect. *w.* London.
Brit. Columbia Mining Rec. *m.* Victoria, B. C.
Builder. *w.* London.
Bulletin American Iron and Steel Asso. *w.* Philadelphia, U. S. A.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. Soc. Int. d Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *m.* Montreal.
Canadian Mining Review. *m.* Ottawa.
Cassier's Magazine. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.
Comptes Rendus de l'Acad. des Sciences. *w.* Paris.
Consular Reports. *m.* Washington.
Deutsche Bauzeitung. *b-w.* Berlin.
Domestic Engineering. *m.* Chicago.
Electrical Engineer. *w.* London.
Electrical Review. *w.* London.
Electrical Review. *w.* New York.
Electrical World and Engineer. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Electricity. *w.* London.
Electricity. *w.* New York.
Electrochemical Industry. *m.* Philadelphia.
Electrochemist & Metallurgist. *m.* London.

Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnische Zeitschrift. *w.* Berlin.
Elettricita. *w.* Milan.
Engineer. *w.* London.
Engineer. *s-m.* Cleveland, U. S. A.
Engineering. *w.* London.
Enginering and Mining Journal. *w.* New York.
Enginering Magazine. *m.* New York & London.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penna. *m.* Pittsburg, U.S.A.
Feilden's Magazine. *m.* London.
Fire and Water. *w.* New York.
Foundry. *m.* Cleveland, U. S. A.
Gas Engineers' Mag. *m.* Birmingham.
Gas World. *w.* London.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Giorn. Dei Lav. Pubb. e. d. Str. Ferr. *w.* Rome.
Glaser's Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Horseless Age. *w.* New York.
Ice and Refrigeration. *m.* New York.
Ill. Zeitschr. f. Klein u. Straussenbahnen. *s-m.* Berlin.
Indian and Eastern Engineer. *m.* Calcutta.
Ingeneria. *b-m.* Buenos Ayres.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron and Steel Trades Journal. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. Am. Foundrymen's Assoc. *m.* New York.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal of Electricity. *m.* San Francisco.
Journal Franklin Institute. *m.* Philadelphia.
Journal of Gas Lighting. *w.* London.
Journal Royal Inst. of Brit. Arch. *s-qr.* London.
Journal of Sanitary Institute. *qr.* London.
Journal of the Society of Arts. *w.* London.
Journal of U. S. Artillery *b-m.* Fort Monroe, U.S.A.
Journal Western Soc. of Eng. *b-m.* Chicago.
Journal of Worcester Poly. Inst., Worcester, U.S.A.
Locomotive. *m.* Hartford, U. S. A.
Locomotive Engineering. *m.* New York.
Machinery. *m.* London.
Machinery. *m.* New York.
Madrid Cientifico. *t-m.* Madrid.
Marine Engineering. *m.* New York.
Marine Review. *w.* Cleveland, U. S. A.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metallographist. *qr.* Boston.
Metal Worker. *w.* New York.
Métallurgie. *w.* Paris.
Minero Mexicano. *w.* City of Mexico.
Minerva. *w.* Rome.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining Reporter. *w.* Denver, U. S. A.
Mitt. aus d Kgl Tech. Versuchsanst. Berlin.
Mittheilungen des Vereines für die Förderung des Local und Strassenbahnwesens. *m.* Vienna.
Modern Machinery. *m.* Chicago.
Monatsschr. d Wurtt. Ver. f Baukunde. *m.* Stuttgart.
Moniteur Industriel. *w.* Paris.
Mouvement Maritime. *w.* Brussels.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *m.* New York.
Nature. *w.* London.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Nineteenth Century. *m.* London.
North American Review. *m.* New York.
Oest. Wochenschr. f. d. Oeff Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg- & Hüttenwesen. *w.* Vienna.
Ores and Metals. *w.* Denver, U. S. A.
Page's Magazine. *m.* London.
Plumber and Decorator. *m.* London.
Popular Science Monthly. *m.* New York.
Power. *m.* New York.
Power Quarterly. New York.
Practical Engineer. *w.* London.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Procedings Engineers' Club. *qr.* Philadelphia.
Pro. St. Louis R'Way Club. *m.* St. Louis, U. S. A.
Progressive Age. *s-m.* New York.
Quarry. *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railroad Digest. *w.* New York.
Railroad Gazette. *w.* New York.
Railway Age. *w.* Chicago.
Railway & Engineering Review. *w.* Chicago.
Review of Reviews. *m.* London & New York.
Revista d Obras. Pub. *w.* Madrid.
Revista Tech. ed Agr. *b-m.* Catania.
Revista Tech. Ind. *m.* Barcelona.
Revue de Mécanique. *m.* Paris.
Revue Gen. des Chemins de Fer. *m.* Paris.
Revue Gen. des Sciences. *w.* Paris.
Revue Technique. *b-m.* Paris.
Revue Universelle des Mines. *m.* Liége.
Rivista Gen. d Ferrovie. *w.* Florence.
Rivista Marittima. *m.* Rome.
Sanitary Plumber. *s-m.* New York.
Schiffbau. *s-m.* Berlin.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Stahl und Eisen. *s-m.* Düsseldorf.
Steam Engineering. *m.* New York.
Stevens' Institute Indicator. *qr.* Hoboken, U.S.A.
Stone. *m.* New York.
Street Railway Journal. *m.* New York.
Street Railway Review. *m.* Chicago.
Telephone Magazine. *m.* Chicago.
Telephony. *m.* Chicago.
Tijds. v h Kljk. Inst. v Ing. *qr.* Hague.
Traction and Transmission. *m.* London.
Tramway & Railway World. *m.* London.
Trans. Am. Ins. Electrical Eng. *m.* New York.
Trans. Am. Ins. of Mining. Eng. New York.
Trans. Am. Soc. of Civil Eng. *m.* New York.
Trans. Am. Soc. of Heat & Ven. Eng. New York.
Trans. Am. Soc. Mech. Engineers. New York.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Transport. *w.* London.
Western Electrician. *w.* Chicago.
Wiener Bauindustrie Zeitung. *w.* Vienna.
Yacht. *w.* Paris.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschrift für Elektrochemie. *w.* Halle a S.

CURRENT RECORD OF NEW BOOKS

NOTE—Our readers may order through us any book here mentioned, remitting the publisher's price as given in each notice. Checks, Drafts, and Post-Office Orders, home and foreign, should be made payable to THE ENGINEERING MAGAZINE.

Annual Review.

L'Année Technique (1901-1902). By A. da Cunha. Size, 11 by 7¼ in.; pp. IV, 271; illustration, 114. Price, paper covers, 3 fr. 50c. ($1.05). Paris: Librairie Gauthier-Villars.

Under the above title, the author gives a general review of industrial and scientific progress in engineering and architecture during parts of the years 1901 and 1902. A great variety of subjects is treated, under the general heads of tramways and traction; cycles and automobiles; public works and architecture; maritime and naval structures and ordnance; and aerial navigation. Among the special objects described are some of the latest types of electric railways; trolley automobiles; suspended railways; movable stations; new types of motor vehicles; ferry bridges; bascule bridges; lighthouses; submarine boats; turbine steamers; life-saving floats; air ships and balloons. These and many other matters of interest to the engineer are well illustrated and described, and the book makes a very readable record of engineering progress.

Cyclopedia.

Universal Cyclopedia and Atlas. Charles Kendall Adams, LL.D., Editor-in-Chief. Rossiter Johnson, Ph. D., LL. D., Editor of Revision. Size, 11 by 8 in.; 13 volumes, including index volume. Colored plans and maps, plates and engravings. Price, cloth, $72. New York: D. Appleton and Company.

On its first appearance, in 1874, this work was known as Johnson's Universal Cyclopedia. Since then it has been revised several times, important articles have been rewritten and new ones added, many of them by leading specialists. The present edition has been issued under the direction of President Adams and Dr. Johnson, assisted by a large staff of associate editors, contributors and revisers. This cyclopedia is too well known to need any description, and its merits are too well acknowledged to need any commendation. The march of events is so rapid nowadays that it is extremely difficult for any work of reference to keep up-to-date, but, on the whole, this has been very well done here, and some of the latest information is embodied in appendices, at the end of each volume. Under the head of Electric Motor, the Lauffen-Frankfort power transmission, in 1891, which is rather ancient history, is given as an example of long-distance transmission, and in the same paragraph, a typographical error, several times repeated, makes "Drehstrom," or rotary current, masquerade under the name of "Orehstrom." On the other hand, however, the map of Africa, besides giving all the latest known geographical features, shows the new political divisions which have resulted from the South African war, and altogether, the high reputation of this work has been well preserved.

Electrical Engineering.

The Elements of Electrical Engineering. A First Year's Course for Students. By Tyson Sewell, A. I. E. E. Size, 8 by 5½ in.; pp. 332; figures, 204. Price, $3. New York: D. Van Nostrand Company. London: Crosby, Lockwood and Son.

This book, by the assistant lecturer and demonstrator in electrical engineering at the Polytechnic, Regent Street, London, is based upon courses of lectures given by him to students desirous of qualifying as electrical engineers, and the subject matter has been treated, as far as possible, on easy and non-mathematical lines. After the introductory portions, there are chapters on the heating and magnetic effects of the electric current, the magnetisation of iron, primary batteries, accumulators, indicating instruments, electricity-supply meters, measuring instruments, electrical measurements, are lamps, incandescent lamps and photometry, the continuous-current dynamo, and direct-current motors. The wide field here indicated is well covered, and the book should prove very acceptable to those for whom it is primarily intended, namely, students who have only a limited time for study and who are attending evening and other courses of instruction at polytechnic and technical schools.

Electricity.

The How and Why of Electricity. A Book of Information for Non-Technical Readers. By Charles Tripler Child. Size, 7¾ by 5¼ in.; pp. 127; figures, 40. Price, $1. New York: Electrical Review Publishing Co.

The author of this book had a wide experience in electrical work, and at the time of his death, he was the technical editor of the *Electrical Review*, of New York. Besides having a thorough knowledge of electricity, both in its theoretical and practical aspects, he possessed that far rarer gift: the power of expressing his knowledge so lucidly and plainly that he could be understanded of the people as well as by the trained technical man. The enormous increase in the applications of electricity, of late, has made it inevitable that the average man should be brought into more or less intimate contact with various kinds of electrical apparatus, and it seems natural that he would desire to know something about the machines and instruments he handles or sees in operation all about him, and through whose agency he is enabled to live the modern life. The purpose of this little book is to give the non-technical man just this information, and it tells in clear and simple language, aided by appropriate illustrations, how electricity is generated, handled, controlled, measured and set to work, and how familiar electrical apparatus operates. It is understood that the proceeds of the sale of this book will, to a large extent, be paid to the widow and children of the author.

Engineering.

Ancient and Modern Engineering and the Isthmian Canal. By William H. Burr, C. E. Size, 9¼ by 6½ in.; pp. XV, 473; profusely illustrated with half-tones, plans and diagrams. Price, $3.50; postage, 27 cents additional. New York: John Wiley & Sons. London: Chapman & Hall, Ltd.

Columbia University, where the author is the professor of civil engineering, in the course of its university extension work has provided for lectures to the people of New York, and this book is the outcome of a series of six lectures delivered at the Cooper Union, the substance of which addresses has been suitably expanded for the purposes of publication. The book is divided into six main parts: Ancient civil-engineering works; bridges; water-works for cities and towns; railroad engineering; the Nicaragua route for a ship canal; and the Panama route. The lectures, as originally delivered, were of a more or less popular character, but the book while preserving the easy style of the addresses, which makes it both pleasant and interesting to read, has become more technical in substance, particularly in the section devoted to bridges, which is the author's specialty. The parts which are, perhaps, of the greatest present interest, are those on the two principal competing routes for the Isthmian Canal, the Panama and the Nicaragua. The author, as a member of the Isthmian Canal Commission, has made personal examinations of both these routes and therefore speaks with the fullest knowledge of his subject. Not only these parts, however, but the whole book presents a body of interesting technical information of the highest practical value, in an agreeable and attractive manner.

Engineering Education.

Society for the Promotion of Engineering Education. Proceedings of the Tenth Annual Meeting Held in Pittsburg, June, 1902. Volume X, and Index, Vols. I-X. Edited by Robert Fletcher, Calvin M. Woodward and Clarence A. Waldo. Size, 9 by 6 in.; pp. XXXII, 300. Price, $2.50. New York: Engineering News Publishing Co.

The papers and discussions forming the principal part of this book cover a wide range of topics relating to engineering education and to education in general, and besides the record of the proceedings, there are included in this volume lists of members of the Society, the constitution, and memoirs of deceased members. Among the latter is an appreciative notice of Prof. J. B. Johnson, late dean of the College of Engineering of the University of Wisconsin, whose portrait also forms the frontispiece of the book, and who was the founder of The Engineering Index. There are two unique features of the present volume: One is the statistical report on the present status of engineering education in the United States, Canada, Australia and England, with tables showing the number of students in the various departments and classes of the engineering colleges. The other special feature is the combined index of the first ten annual volumes of the Society, now making available what is probably the largest and most important single collection of essays and discussions in the English language on the subject of engineering education.

BOOKS ANNOUNCED.

Locomotives: Simple, Compound, and Electric. 4th edition. By H. C. Reagan. Price, $2.50. New York: John Wiley & Sons. London: Chapman & Hall, Ltd.

The Steam Turbine. By Robert M. Neilson. Price, $2.50 (7s. 6d.). London, New York and Bombay: Longmans, Green, & Co.

Economics of Forestry. By Bernhard E. Fernow, LL. D. Price, $1.65. New York: Thomas Y. Crowell & Co.

NEWS SUPPLEMENT

The Engineering Magazine—February, 1903

Coming Society Meetings.

AIR-BRAKE ASSOCIATION. Sec.: F. M. Nellis, 174 Broadway, New York. Annual meeting, April 28, Colorado Springs.

AMERICAN BOILER MANUFACTURERS' ASSOCIATION. Sec.: J. D. Farasey, Cleveland. Next meeting, July, 1903, at Chattanooga.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Sec.: Ralph W. Pope, 95 Liberty St., New York. Regular meeting on fourth Friday of each month, 12 W. 31st St., New York. Feb. 27: Papers on "Railway Train Lighting."

AMERICAN INSTITUTE OF MINING ENGINEERS. Sec.: R. W. Raymond, 99 John St., New York. Thirty-third annual meeting, Feb. 17, etc., Albany, N. Y.

AMERICAN RAILWAY ASSOCIATION. Sec.: W. F. Allen, 24 Park Place, New York. Meeting, April 22, 1903, New York.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION. Sec.: L. C. Fritch, Monadnock Block, Chicago. Annual meeting, March 17 and 18, Chicago.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Sec.: J. W. Taylor, 667 Rookery, Chicago. Meeting, June 22, etc., Mackinac Island, Mich.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Sec.: C. W. Hunt, 220 W. 57th St., New York. Regular meetings, first and third Wednesdays of each month.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Sec.: Prof. F. R. Hutton, 12 W. 31st St., New York. Semi-annual meeting, June, at Saratoga.

BOSTON SOCIETY OF CIVIL ENGINEERS. Sec.: S. E. Tinkham, 715 Tremont Temple. Regular meetings on third Wednesday of each month, except January, when on fourth Wednesday.

CANADIAN RAILWAY CLUB. Sec.: W. H. Rosevear, Jr., Montreal. Regular meetings on first Tuesday of each month.

CANADIAN SOCIETY OF CIVIL ENGINEERS. Sec.: Prof. C. H. McLeod, 877 Dorchester St., Montreal. Regular meetings every alternate Thursday.

CENTRAL RAILWAY CLUB. Sec.: Harry D. Vought, 62 Liberty St., New York. Regular meetings on second Fridays of Jan., March, May, Sept. and Nov., Hotel Iroquois, Buffalo.

CHICAGO ELECTRICAL ASSOCIATION. Sec.: W. J. Warder, Jr., 900 Warren Ave. Regular meetings on first Friday of each month.

CIVIL ENGINEERS' CLUB OF CLEVELAND. Sec.: Arthur A. Skeels, 689 The Arcade. Regular meetings on second and fourth Tuesdays of each month.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL. Sec.: G. S. Edmondstone. Regular meetings on second Monday of each month.

ENGINEERING ASSOCIATION OF THE SOUTH. Sec.: H. M. Jones, 1000 Broad St., Nashville, Tenn. Regular meetings on second Thursday of each month at Vanderbilt University.

ENGINEERS' CLUB OF CHICAGO. Sec.: B. W. Thurtell, 1223 New York Life Building. Regular meetings on first and third Tuesdays of each month.

ENGINEERS' CLUB OF CINCINNATI. Sec.: J. F. Wilson, P. O. Box 333. Regular meetings on third Thursday of each month.

ENGINEERS' CLUB OF COLUMBUS (OHIO). Sec.: H. M. Gates, 12½ North High St. Regular meetings on first and third Saturdays of each month.

ENGINEERS' CLUB OF MINNEAPOLIS. Sec.: Edw. P. Burch, 1210 Guaranty Bldg. Regular meetings on third Monday of each month.

ENGINEERS' CLUB OF PHILADELPHIA. Sec.: L. F. Rondinella, 1122 Girard St. Regular meetings on first and third Saturdays of each month.

ENGINEERS' CLUB OF ST. LOUIS. Sec.: H. J. Pfeifer, 920 Rialto Bldg. Regular meetings on first and third Wednesdays of each month.

ENGINEERS' SOCIETY OF WESTERN NEW YORK. Sec.: L. W. Eighmy, 13 City Hall, Buffalo. Regular meetings, first Tuesday of each month.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA. Sec.: Chas. W. Ridinger, 410 Penn Ave., Pittsburg. Regular meetings on third Tuesday of each month.

FRANKLIN INSTITUTE. Sec.: Dr. Wm. H. Wahl, 15 South 7th St., Philadelphia. General meetings on third Wednesday of each month. Regular monthly meetings of the various sections on other days.

IOWA RAILROAD CLUB. Sec.: P. B. Vermillion, Des Moines, Iowa. Regular meetings on third Tuesday of each month.

LOUISIANA ENGINEERING SOCIETY. Sec.: G. W. Lawes, 806 Gravier St., New Orleans. Regular meetings on the second Monday of each month. Annual meeting, Jan. 10.

MASTER CAR BUILDERS' ASSOCIATION. Sec.: J. W. Taylor, 667 Rookery, Chicago. Meeting, June 17, etc., Mackinac Island, Mich.

MODERN SCIENCE CLUB. Sec.: R. Henderson, 302 Livingston St., Brooklyn. Meetings every Tuesday.

MONTANA SOCIETY OF ENGINEERS. Sec.: Richard R. Vail, Butte, Mont. Regular meetings on second Saturday in each month.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Sec.: James B. Cahoon, 136 Liberty St., New York. Meeting, May, Chicago.

NEW ENGLAND RAILROAD CLUB. Sec.: Edw. L. Janes, Back Bay P. O., Boston. Regular meetings, second Tuesday in each month, at Pierce Hall, Copley Square.

NEW YORK RAILROAD CLUB. Sec.: F. M. Whyte, N. Y. C. & H. R. R. R. Regular meetings on third Friday of each month except June, July and August, at Carnegie Hall, 154 W. 57th St., New York.

NORTH-WEST RAILWAY CLUB. Sec.: T. W. Flannagan, Minneapolis, Minn. Regular meetings on first Tuesday after second Monday of each month, alternating between Minneapolis and St. Paul.

PACIFIC COAST RAILWAY CLUB. Sec.: C. C. Borton, West Oakland, Cal. Regular meetings on third Saturday of each month, at San Francisco.

PACIFIC NORTHWEST SOCIETY OF ENGINEERS. Sec.: G. F. Cotterill, Seattle, Wash. Meetings monthly in Chamber of Commerce rooms, Seattle.

RAILWAY CLUB OF PITTSBURGH. Sec.: J. D. Conway, P. & L. E. R. R., Pittsburgh, Pa. Regular meetings on fourth Friday of each month at Hotel Henry.

RAILWAY SIGNALING CLUB. Sec.: B. B. Adams, 32 Park Place, New York. Regular meetings on second Tuesday of January, March, May, Sept. and Nov.

RICHMOND RAILROAD CLUB. Sec.: F. O. Robinson, 8th & Main Sts., Richmond, Va. Regular meetings on second Thursdays.

ROCKY MOUNTAIN RAILWAY CLUB. Sec.: J. E. Buell, 906 20th Ave., Denver. Regular meetings on first Saturday after the 15th of each month.

ST. LOUIS RAILWAY CLUB. Sec.: E. A. Chenery., Union Station, St. Louis. Regular meetings on second Fridays.

SOCIETY OF CHEMICAL INDUSTRY, NEW YORK SECTION. Sec.: H. Schweitzer, 40 Stone St. Meetings on third Friday after the first Monday of each month, at Chemists' Club, 108 W. 55th Street.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB. Sec.: W. A. Love, Atlanta, Ga. Regular meetings on third Thursday of Jan., April, Aug. and Nov.

TECHNICAL SOCIETY OF THE PACIFIC COAST. Sec.: Otto von Geldern, 31 Post St., San Francisco. Regular meetings on first Friday of each month.

TEXAS RAILWAY CLUB. Sec.: T. H. Osborne, Pine Bluff, Ark. Regular meetings on third Monday of April and September.

WESTERN RAILWAY CLUB. Sec.: Jos. W. Taylor, 667 Rookery, Chicago. Meetings on third Tuesday of each month, Auditorium Hotel, Chicago.

WESTERN SOCIETY OF ENGINEERS. Sec.: J. H. Warder, Monadnock Block, Chicago. Regular meetings on first Wednesday and extra meetings on third Wednesday of each month.

Personal.

—Mr. Daniel W. Pedrick is no longer connected or interested in any way with the Pedrick & Ayer Co. His entire time and attention is now given to H. B. Underwood & Co., of Philadelphia, of which firm he is the senior partner. He has been a partner of this firm since its organization, and is now manufacturing portable cylinder boring bars and other portable tools for railway repair shops of the same high grade and quality as he made when he was with the Pedrick & Ayer Co.

—Mr. A. Kennedy Ashworth, formerly of the firm of D. Ashworth & Son, consulting steam engineers, and later for a number of years in charge of the engineering department of the Pittsburgh Gage & Supply Co., has accepted service as assistant manager of the Underfeed Stoker Co., with headquarters in the Marquette Building, Chicago.

—Mr. G. V. Flynn, the electrical contractor, has recently formed a connection with Wm. K. Bassford, Jr., of Newark, N. J., consulting electrical engineer and expert, and designer and builder of electrical machinery.

—Mr. J. Adams Heinson has resigned his position as advertising manager of the H. B. Smith Machine Co., in order to create and conduct a promotion department for the Manhattan Electrical Supply Co., of New York and Chicago, with offices at 32 Cortlandt street, New York.

—Mr. W. M. Cosgrove, who has for many years been connected with the A. A. Griffing Iron Company, has been appointed general sales manager of his company, with headquarters at their New York office, 66 and 68 Centre Street. Mr. Cosgrove entered their employ on May 24th, 1888, and has occupied various positions, such as clerk, traveling salesman, and New York manager, thus fitting him for the responsible position of general sales manager, to which he has now been appointed. Mr. Cosgrove entered upon his duties with the beginning of 1903.

—Mr. George K. Hooper, consulting engineer, who makes a specialty of the design of manufacturing plants and of cost reduction in present plants, has opened an office in the Bowling Green Building, 11 Broadway, New York, as the growth of his business has made it necessary for him to have increased facilities for its transaction.

—Prof. J. J. Thomson, F. R. S., Cavendish Professor of Experimental Physics at Cambridge University, has been called to the chair of physics at Columbia University, left vacant by the death of Prof. O. N. Rood.

—Mr. F. E. Drake, formerly Director of Machinery and Electricity for the United States at the Paris Exposition, has just returned from Europe. It will be remembered that the idea of a special building at Paris for American machinery was original with Mr. Drake, who personally assumed all responsibility for the project, carrying it through to successful completion without government aid. Since the exposition, Mr. Drake has been engaged in the complete reorganization of the plant and technical departments of the great Union Elektricitäts Gesellschaft of Berlin. The officials of that company tendered Mr. Drake and his assistant, Mr. C. S. Colton, a testimonial banquet at the Hotel Bellevue, which was presided over by Herr Commerzienrath Loewe.

—Mr. William Perkins Tyler's death is announced with deep regret. He was president of the Tyler Tube & Pipe Company, which he founded in 1890, and he devoted the last twelve years of his life to its development, winning not only the respect and regard of his business associates, but the friendship of the many employees of the company. Mr. Tyler's interest in the business will remain undisturbed, and his associates, who have had the benefit of an intimate knowledge of his methods and purposes, will continue the business on the same lines as heretofore.

Industrial Notes.

—Messrs. C. H. Sanders and W. S. Rising, who are practical toolmakers and machinists, have formed a partnership under the name of Sanders and Rising, at Los Angeles, California, for the purpose of manufacturing fine tools and light machinery, and performing experimental work. They are prepared to build any kind of stamping and drawing dies for metal work, and special tools and light machinery requiring accuracy and good workmanship and design.

—Mr. R. W. Lesley, Assoc. Am. Soc. C. E., and president of the American Cement Co., has written a very interesting historical and descriptive review of the cement industry in general and of the American Portland cement industry in particular. This essay, which is well illustrated, forms a supplement to the 29th annual report of the Bureau of Industrial Statistics of the State of Pennsylvania. Among other features of this work, there are tables and diagrams showing the enormous growth of the Portland cement industry in the United States, where the annual production increased from about 500,000 barrels to nearly 13,000,000 barrels in the decade from 1891 to 1901. Pennsylvania is the leading State in this industry, producing about 55 per cent. of the total amount of cement made in the whole country.

—Robert W. Hunt & Co. have been given the inspection of 350 steel ore cars to be built by the Pressed Steel Car Co. for the Duluth, Mesaba & Northern R. R. Co., and 450 of the same class of cars, to be built by the same company for the Duluth & Iron Range R. R. Co. In addition, for the latter road they have a small order of 75 flat and box cars to be built at Hegewisch, Ill. They also have the inspection of 500 steel-underframe box cars, to be built at Berwick, Pa., for the Philadelphia & Reading R. R. Co., and 500 steel hopper coal cars for the same road, to be built at Butler, Pa. They have just been given the inspection of 1,600 box and 500 stock cars, with pressed steel underframes, to be built at Hegewisch, Ill., for the Southern Pacific R. R. Co., and 1,000 flats, with pressed steel underframes, to be built for the same road, by the Pressed Steel Car Co., at their McKee's Rocks plant. They are engaged upon the inspection of 300 gondola cars for the Bellington & Beaver Creek R. R. Co., at Jeffersonville, Ind., and 110 coal cars for the East St. Louis & Suburban R. R. Co., to be built at Madison, Ill. The firm report their locomotive inspection department very busy at the various works. They have just received instructions to inspect 27 locomotives at the Baldwin Locomotive Works, for the Wheeling & Lake Erie Ry. Co., and they have been given an additional order by the Hocking Valley R. R. Co., for the inspection of 12 switching engines, to be built at the Brooks Works.

—During the last two months, the Illinois Central's big coal pile at Gwinn, Miss., has been on fire, the blaze having been caused by spontaneous combustion. After vainly

trying for weeks to extinguish the fire, it was decided that the coal must be removed. Louis Montville, whose steam shovels have been put to such good use in the gravel pit, was sent for, and in nine days removed fifteen thousand tons of coal. It was necessary to keep a hose playing on the pile of coal all the time, and even with this precaution, four cars were set on fire by the hot coal. This is the first time that a steam shovel has ever been used for such a purpose, and Mr. Montville's successful attempt opens up a new avenue of usefulness for this wonderful machine, which in the present instance was of the "Giant" boom type, built by the Vulcan Iron Works Company of Toledo, Ohio. The latter company have, during the past year, been selling their steam shovels as fast as they could make them, and they have orders booked far into 1903. The demand during 1902 exceeded that of any previous year, and their shops are now undergoing extensive additions to accommodate the increase of business.

—The new French battleships, "La Patrie" and "La Republique," of 18,000 H. P. each, will be equipped with Niclausse boilers.

—The Eureka Fire Hose Co., of 13 Barclay street, New York, are sending to manufacturers and others who use fire hose or garden hose a very neat pocket souvenir in the shape of a combination lead pencil and eraser.

—The Sterling Varnish Co., of Pittsburg, Pa., announce that their present European address is Brougham Street, Blackfriars Road, Salford-Manchester, England, where all communications relative to their foreign business should be addressed.

—The Central and Trunk Line Passenger Associations have acted favorably on the application of The Merchants' Association of New York for reduced rates to that city for the spring buying season.

—The Southern Pacific and Union Pacific have given individual notices to the Trans-Continental Passenger Association, to make colonists' rates to California points, effective Feb. 15th to April 30th, as follows: From Chicago, $33; from Missouri River points and Houston, Texas, $25; from St. Louis, Memphis and New Orleans, $30, and from eastern cities, about $50. This action on the part of the Southern Pacific and Union Pacific gives another opportunity to persons of moderate means to travel to the Pacific Coast at little expense, which opportunity should be grasped by all who have a desire either to visit or settle in the Golden State.

—The Snider-Hughes Company, manufacturers of steam pumps, take pleasure in making the announcement that the increase in their business having rendered it necessary to remove into larger and more commodious shops and offices, they have vacated their old quarters at the corner of Hamilton and Coe streets, and are now installed in their new building at Sheridan street and Pa. R. R., Cleveland.

—The American School of Correspondence has just made an arrangement with Prof. F. B. Crocker, head of the department of electrical engineering, at Columbia University, to act on its advisory board and prepare some of its electrical papers.

—The Q and C Company have recently shipped from their factory at Chicago Heights, one of their largest special metal-sawing machines to the United States Government, to be used at the Cavite Navy Yard, at Manila.

—The Pittsburgh Gage & Supply Co., of Pittsburgh, has received an order from the Pittsburgh Coal Co. for six 150-horse-power tubular boilers, destined for its various mines, and from the Penfield Coal Co., Penfield, Pa., orders for one 40-horse-power Chandler & Taylor engine and one 50-horse-power horizontal tubular boiler.

—The Western Electric Company reports very gratifying results from its constant-potential alternating arc lamp. This lamp operates on the repulsion principle, and the favor with which central station managers have received this lamp is a tribute to its intrinsic worth.

—A new four-story building, 186 feet by 70 feet, for the departments of mechanical engineering, mining engineering, and geology at Lehigh University, is in process of construction.

—Among recent orders received by the American Blower Co. of Detroit, Mich., are six large steel-plate fans with electric motors for public baths in New York City, heating and ventilating apparatus for a school at Delray, Mich.; schools Nos. 26

and 53, Buffalo, N. Y.; Hibernian Bank & Trust Co., New Orleans; the Deming Co., Salem, O.; Arbuckle Bros., New York City; Mishawaka (Ind.) Woolen Mfg. Co.; M. B. Martin Co., Grand Rapids, Mich. Also mechanical-draft apparatus for the American Brewing Co., Indianapolis, and the Douglas Improvement Co., Douglas, Ariz.; and drying outfits for the Palmer Mfg. Co., Detroit, Harbison & Walker Co., Hays Station, Pa., and the Canton & Malvern Fire Brick Paving Co., Akron, O.

—The Christensen Engineering Co. have opened an office in the Merchants Loan & Trust Bldg., Chicago, for the sale of their "Ceco" electrical machinery. The company have been particularly fortunate in securing the services of Mr. Chas. G. Burton as the manager of the Chicago agency. Mr. Burton is well and favorably known in the electrical field through his previous connection for several years with the Central Electric Co., and later for three years with the Westinghouse Electric & Mfg. Co. He left the latter company in the early part of 1902, to install a power and transmission system, resigning recently to accept his present position with the Christensen Company.

—The New York Continental Jewell Filtration Company report that they have received an order from the York Water Works, York, England, for an additional filter plant, to have a daily capacity of 2,000,000 imperial gallons. The Filter Company installed a filter plant at York last year with a daily capacity of 4,000,000 gallons, which is to be now increased to 6,000,000 gallons. The same company also report an order from the Hungarian Government for the equipment of the Royal Hungarian R. R. near Buda Pesth; and one for an addition to the boiler feed water purifying plant at the 179th street pumping station of the Water Department of New York City.

—The Sprague Electric Company supplied a large amount of flexible metallic conduit and steel-armored conductors for the new addition to the White House in Washington, and has also received additional orders for ventilating outfits for the same building.

—The extent to which the aid of electricity is being invoked in promoting comfort and convenience in dwellings is well illustrated by a recent contract made by the Otis Elevator Company to install five electric elevators in a single private residence. In the house which is now being erected at Madison avenue and 37th street, New York, for Capt. J. R. DeLamar, the elevator equipment is to consist, first, of a passenger elevator, a servants' elevator and a dumbwaiter, all to be automatically controlled by push buttons within the cars and at the several landings. In addition the contract calls for a sidewalk elevator for ashes, etc., and an automobile lift for conveying motor cars from the street level to a storage room in the sub-basement.

—The mechanical draft feature of the Union Electric Light & Power Company's plant, which will be used for lighting the World's Fair grounds at St. Louis, will be an installation of great interest to engineers. The plant is to be equipped with both forced and induced draft apparatus, which is unusual. There will be 26 boilers of 700 H. P. each, equipped with automatic stokers. Fans will be used for the forced draft, and the boilers will also be operated under induced draft. The forced draft fans will be four in number, of the full housing type, size 160 inches. They will be driven by 10-inch by 10-inch vertical engines, direct connected. The induced draft fans will be two in number, of a size quite in keeping with the basis upon which the Exposition is being built, the wheel diameters being of a dimension seldom met with in mechanical-draft engineering. Each of these induced draft fans will be of the full housing type, size 230 inches, and will be driven by 9-inch by 10-inch double-cylinder, double-acting, upright engines, this type being selected to secure the maximum power in a limited space. The Buffalo Forge Co. is building all the fans and engines for the above equipment.

—Mr. J. W. Duntley, president of the Chicago Pneumatic Tool Company, has arrived in Chicago after a remarkably successful European trip. Mr. Duntley's principal object in making this trip was to establish in Europe a new plant for the manufacture of pneumatic machinery, and he accomplished his purpose, making arrangements for the erection of a works at Fraserburg, in Aberdeenshire, Scotland, which will cost approximately $175,000. The

necessary machinery for it will be purchased in this country. Mr. Duntley also made an arrangement with a large German factory to manufacture his company's tools on a contract.

—The constant growth of the demands for power has made it necessary for the New York Edison Company to make arrangements for new generators, rotary converters and transformers. The Stanley Electric Manufacturing Company has secured, through its New York office, this important contract, which is notable not only on account of the total amount involved but also because of the unusual size of the units. The first item in the contract is for four 2,000-kilowatt S. K. C. rotary converters. The transformer equipment to accompany these machines consists of twelve 800-kilowatt S. K. C. static transformers, of the air-blast type, and four auto-regulators. As is generally known, the largest rotaries hitherto built are the 1,500-kilowatt units in the Manhattan sub-stations, and therefore the construction of those of 2,000-kilowatt capacity marks a distinct advance in the art. In addition, the contract calls for ten 1,000-kilowatt S. K. C. rotary converters, with thirty 400-kilowatt S. K. C. static transformers of the air-blast type and ten auto-regulators. The above apparatus is to be placed in various sub-stations of the Edison system. Furthermore, the Stanley Electric Manufacturing Co. is to furnish three new generating units for the Edison Waterside Station. The machines are to be 3,500-kilowatt, 25-cycle, three-phase, alternating-current generators, direct-connected to engines working at 75 revolutions per minute.

—The managers of the Pennsylvania Railroad, in planning the construction of their great terminal in New York, which includes tunnels under the Hudson and the East River, have, with their usual farsightedness, adopted a broadminded policy which promises to be very effective. They evidently conceived of this work as composed of four main parts; the tunnels, the architecture, the mechanical and electrical engineering, and the bringing of the railroad into and through the tunnels and terminal. They therefore created a commission of engineers to design and supervise the construction of the tunnels; appointed architects for the structures and engineers for the mechanical and electrical equipment; while their own chief engineer's department brings the road into the property thus created. The commission consists of Col. Chas. W. Raymond, C. E., U. S. Army Engineer N. Y. Harbor, Chairman; Chas. M. Jacobs, C. E., Chief Engineer North River Section; Alfred Noble, C. E., Chief Engineer East River Section; William H. Brown, Chief Engineer Pennsylvania Railroad, in charge of Tracks and Terminal Yards; Gustav Lindenthal, C. E., Bridge Commissioner of New York City; Geo. Gibbs, M. E., First Vice-President of Westinghouse, Church, Kerr & Co., in charge of Mechanical Engineering, Electric Locomotives and Traction. It will thus be noted that the work is again departmented within the members of this commission. The architectural work has been delegated to Messrs. McKim, Mead & White, whose large previous undertakings have perfected the necessary organization for this extensive work, and insure an artistic conception which will be in keeping with the relation of these structures to the purpose and with the city structures of which this terminal will be the conspicuous central feature. Westinghouse, Church, Kerr & Co. have been appointed the mechanical and electrical engineers and constructors of the extensive and varied work which is to be carried on in many departments of the undertaking, their organization, already developed on other large work, automatically systematizing this work along the regular lines in which their engineering and construction operations are regularly conducted. Following upon this appointment, the architects then made Westinghouse, Church, Kerr & Co., their engineers for this work, giving a peculiar roundness and self-contained relationship between these divisions, analogous to the relationship between the engineers and the commission, through the membership of this firm's first vice president on the commission. A more effective weaving together of co-operative effort could scarcely have been conceived. These organizations, working with the chief engineer and the management of the Pennsylvania Railroad, give the greatest assurance of doing this work both expeditiously and with the highest economy and efficiency.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Conveyors.

October, 1902, bulletin, with illustrated descriptions of gravity bucket and pan-and-bucket conveyors and their parts, and other conveying machinery, and also illustrations of plants where such machinery is installed, and plans for its adaptation to locomotive coaling stations and other plants. 6¼ by 8½ in.; pp. 38. Steel Cable Engineering Co., Boston, Mass.

Correspondence School.

Catalogue, Series No. 18, with illustrations of Armour Institute, lists of officers, instructors, advisory board and graduates, requirements for admission, descriptions of courses of study, specimen examination papers and corrections, and other information. 9¾ by 6¼ in.; pp. 74. American School of Correspondence at Armour Institute of Technology, Chicago.

Dynamotors.

Bulletin No. 139, with illustrated descriptions and tables of data of dynamotors and motor generators for many kinds of electrical service. 9¾ by 6¾ in.; pp. 20. The Holtzer-Cabot Electric Co., Boston (Brookline), Mass.

Elblight.

Large pamphlet with a general description of the Elblight system for electric display illumination, decorative lighting, signs, emblems, etc., and half-tone illustrations of many elaborate installations of this system, which consists, essentially, of flexible cables, specially prepared surfaces and incandescent lamps provided with sharp pin terminals, which light wherever they are stuck. 12 by 9¼ in.; pp. 44. Elblight Company of America, New York.

Electrical Supplies.

Illustrated catalogue No. 14, with descriptions and prices of electric light, household, telephone, telegraph and railway electrical supplies; list of electric books; telegraph code; and index. 8¾ by 5¾ in.; pp. 557. Manhattan Electrical Supply Co., New York.

Electric Apparatus.

Bulletins Nos. 4299, 4300, 4301, 4302 and 4303, devoted, respectively, to the prepayment meter; direct-driven, continuous-current generators for lighting and power; arc lighting; service cut-out; and searchlight projectors. 10½ by 8 in. Also catalogue of electrical apparatus and supplies for isolated plants, catalogues and price lists of various supplies, and flyer devoted to I-beam insulators. General Electric Co., Schenectady, N. Y.

Bulletins, in paper binder, with illustrations and descriptions and price lists of electric fan motors, electric power motors, automatic start induction motors, electric exhaust fans, electric coffee mills, dental and surgical electric air pumps, and other electric apparatus. 10 by 7½ in. The Emerson Electric Mfg. Co., St. Louis.

Filter Presses.

Circulars with illustrations and tables of data of filter presses of various kinds, such as circular, center-feed, open delivery; three and four-eyed, closed delivery; two-eyed, open-delivery, etc., and for many purposes. T. Shriver & Co., 333 East 56th St., New York.

Fuel-Oil Equipments.

Catalogue which gives information about ordinary steam plants equipped for the use of oil as fuel, with illustrations and descriptions of oil burners, pipes, tanks, regulators and other fuel-oil apparatus. 6 by 9 in.; pp. 24. The Petroleum Iron Works Co., Washington, Pa.

Gas Engines.

Catalogue, with illustrations and descriptions of the Capital gas and gasoline engines—stationary, portable, traction and marine—made in sizes of from 2 to 200 horse power. Testimonials and telegraph code. 7 by 10 in.; pp. 34. C. H. A. Dissinger & Bro., Wrightsville, Pa.

Catalogue No. 11, with illustrations and descriptions of gas, gasoline and oil engines for various kinds of service, including pumping engines, portable engines, and hoisting engines, to be operated with gasoline, kerosene, distillate, or crude oil, and manufactured, natural or producer gas. 9 by 6 in.; pp. 31. Model Gas Engine Co., Auburn, Indiana.

Grates and Blowers.

Catalogue, with descriptions and illustrations of McClave's improved shaking and cut-off grate and argand steam blower, the two together forming a complete system for burning the cheaper grades of fuel. 6¾ by 9 in.; pp. 48. McClave-Brooks Co., Scranton, Pa.

Hammers.

Folders, devoted to rubber-cushioned helve hammers, and accessories, such as eccentrics and anvil blocks, upright strap hammers, upright helve hammers, compact hammers and heating forges for hard coal or coke. The Bradley Co., Syracuse, N. Y.

Heating.

Catalogue, with illustrations and descriptions of steam boilers and hot-water heaters of several types, including the "Carton," the "Wheeler Palace," and the "International," which have a remarkably high efficiency. 10½ by 8½ in.; pp. 44. International Heater Co., Utica, N. Y.

Instruments.

Illustrated catalogue and descriptive price list of high-grade engineering and astronomical instruments, including transits, theodolites, levels, the S. S. nautical range-finder, solar attachments, sextants, chronographs, astronomical transit instruments, equatorial telescopes, etc. 9 by 6 in.; pp. 116. George N. Saegmuller, Washington, D. C.

Iron and Brass Goods.

Large, cloth-bound catalogue, with illustrations, descriptions and price lists of brass valves and other brass work, iron body valves and other iron body work, iron pipe fittings, pipe and boiler tubes, pipe machines and tools, and miscellaneous goods for steam, gas and water. 12 by 9 in.; pp. 327. The Eaton, Cole and Burnham Co., New York.

Machinery Supplies.

Very large, heavily-bound catalogue with descriptions, illustrations and prices of a great variety of machinery and supplies for contractors, mills, mines, foundries, furnaces, breweries, railroads and steamboats, including carpenters' and machinists' tools and measuring instruments, hardware, machine tools, boilers, gauges, steam specialties, lubricating apparatus, hoists, etc., etc. 13½ by 11 in.; pp. xxxii, 1032. Somers, Fitler & Todd Co., Pittsburgh.

Mandrels.

Pamphlet entitled "Mandred Talk," with illustrations, descriptions and prices of Nicholson's patent expanding lathe mandrels, and testimonials of users. 9 by 6 in.; pp. 20. W. H. Nicholson & Co., Wilkes-Barre, Pa.

Penstocks.

Pamphlet, entitled "Modern Hydro-Electric Power Stations," with an illustrated description of a novel and economical type of penstock construction in concrete and steel, as used in the new plant of the Michigan Lake Superior Power Co. at Sault Ste. Marie. 12 by 8½ in.; pp. 10. J. W. Rickey, 508 S. First St., Minneapolis.

Presses.

Cloth-bound catalogue and price list, 12th edition, with illustrations and descriptions of presses, drop hammers, shears, dies and special machinery. Telegraph code. 7¼ by 5½ in.; pp. 534. E. W. Bliss Co. and The Stiles & Parker Press Co., Brooklyn, N. Y.

Pumps.

Cloth-bound, illustrated catalogue, 53rd edition, with descriptions and price lists of hand and power pumps and hydraulic and pumping machinery for all purposes. Also, useful figures and formulæ, telegraph code and index. 9¼ by 6¼ in.; pp. 256. Rumsey & Co., Ltd., Seneca Falls, N. Y.

Catalogue, with illustrations, descriptions and prices of efficient power pumps for every service, particularly the triplex power pumps, and also rotary and centrifugal pumps, double-acting piston pumps, triplex air compressor and blower, air compressor and vacuum pumps, working heads for deep wells, electric pumps, etc. Useful information and tables. 7 by 8 in.; pp. 160. The Goulds Manufacturing Co., Seneca Falls, N. Y.

Punches and Shears.

Catalogue No. 20, with illustrated descriptions of punching and shearing machinery, bending machines, spacing tables, beveling and trimming machines, and other machinery for heavy metal work. 9 by 6½ in.; pp. 160. The Long & Allstatter Co., Hamilton, Ohio.

Regulators.

Pamphlet, with illustrated descriptions of automatic pump regulator and low-water alarm, automatic feed-water regulator and low-water alarm, back-pressure regulator, high-and-low-water alarm, and automatic lever damper regulator for steam-generating plants. 6 by 9 in.; pp. 43. Burrows Manufacturing Co., York, Pa.

Rice-Mill Machinery.

Large catalogue, with illustrations, descriptions and prices of rice milling and preparing machinery of all kinds. 11½ by 8½ in.; pp. 31. Also, folder devoted to the "Cinderella" dry concentrator for any kind of mineral or ore. F. H. Schule, Hamburg, Germany, and 27 Thames St., New York.

Scales.

Catalogue No. 346, with descriptions, illustrations and prices of standard scales for all purposes, including portable platform, personal, grocery, army-and-navy, foundry, cotton, warehouse, flour, hopper grain, coal, wagon, stock, railway track, and many other kinds of scales. 7 by 4½ in.; pp. 184. Also catalogue No. 344, with an illustrated price list of druggists', prescription and confectioners' scales; analytical and jewelers' balances; and standard weights and measures. 7 by 4½ in.; pp. 64. E. and T. Fairbanks and Co., St. Johnsbury, Vermont.

Steam Engines.

Folder, with illustrations and table of data of Hardie-Tynes "Corliss" steam engines. Hardie-Tynes Foundry & Machine Co., Birmingham, Alabama.

Steam-Pipe Covering.

Pamphlet, containing a reprint from *Power*, of a paper on "Steam-Pipe Covering and Its Relation to Station Economy," by H. G. Stott, read before the Association of Edison Illuminating Companies, giving a description, with illustrations and diagrams, of tests of many kinds of steam-pipe covering made for the Manhattan Railway Co.'s new power plant, which resulted in the adoption of Carey's 85 per cent. carbonate of magnesia covering. 12 by 9 in.; pp. 8. The Philip Carey Mfg. Co., Lockland, Ohio.

Steam Specialties.

Folders and flyers devoted to the Utility exhaust mufflers, oil separators, return tanks, pump governors, feed-water heaters and other steam specialties for the heating trade. The Standard Steam Specialty Co., 111 Fifth Ave, New York.

Tools.

Catalogue, with illustrations, descriptions and prices of high-grade twist drills, taps and dies, reamers, milling cutters, hack saws and other machinists' fine tools. 9 by 6 in.; pp. 32. The Etna Manufacturing Co., 40 John St., New York.

Wood-Working Machinery.

Catalogue and price list, No. 17 A, with illustrations and descriptions of patent foot and hand power wood-working machinery, including scroll saws, "combination" saws, moulders, mortisers, lathes, etc. 7 by 9 in.; pp. 24. The Seneca Falls Manufacturing Co., Seneca Falls, N. Y.

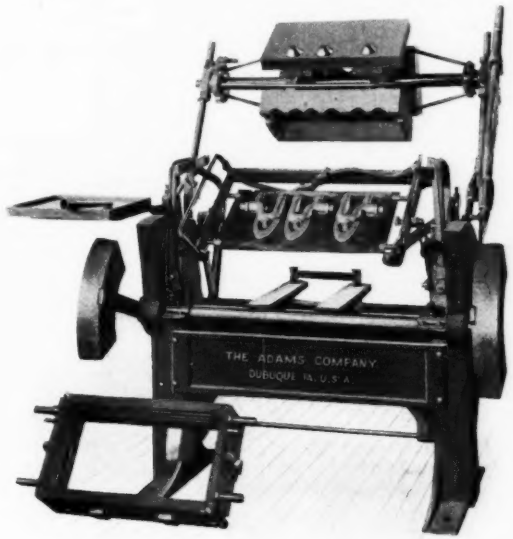
IMPROVED MACHINERY

New Processes and New Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

Automatic Molding Machine.

AN automatic molding machine is to the foundry what the turret lathe is to the machine shop. Its usefulness is limited only by the ingenuity of the pattern maker and by the willingness of the molder to turn out work which requires the minimum of exertion on his part.



AUTOMATIC MOLDING MACHINE.

A leading example of this class of machines is the Farwell, which is illustrated herewith. Its operation is simple and any workman can soon become familiar with it. The machine is designed to make a complete snap mold and by a few rapid and easy motions of the operator, it is made to separate the flask and admit the pattern plate, turn the flask over, and, after sand has been riddled and shoveled into the drag, to pein the latter, clamp on bottom board, turn over, and, after filling the cope, pein the cope, press the mold, cut all sprue holes or draw flat gate, separate the mold, draw the pattern, close the mold and remove the finished mold from the flask, leaving it ready to be placed upon the floor.

The table movement is counterbalanced and is easy and rapid. The links and slides that actuate and guide the vertical movement of the table are encased in the sand-proof hollow legs, and all moving parts have long bearings and are provided with oil reservoirs that require attention but once a week.

The lever is in a horizontal position when pressing the mold and the operator simply leans his weight upon it. It is adjustable to the size of the mold and the weight of the operator, and the largest molds can thus be pressed as easily as the smallest ones. The turret top has three sides, to receive a drag-

peining frame, a cope-peining frame and a presser head, which are alternately brought into position automatically. The flasks may be of any shape and with either straight or irregular parting.

These machines have well stood the test of practical experience, one of them having produced over 700,000 castings, weighing about 8 pounds each, and bidding fair to continue its usefulness for many years.

The Adams Company, of Dubuque, Iowa, manufactures these machines and will be glad to supply any further information about them which may be desired.

Filing Machine.

THE filing machine here illustrated is a new machine for sawing out and filing blanking dies, and for a variety of filing, sawing and slotting work, in many branches of manufacturing.

It uses common files or hack saws. The file clamps are made to take any file from

COCHRANE-BLY FILING MACHINE.

the smallest up to ½-inch thick. The saws are instantly adjusted on pins on the file clamps. The file clears on the return stroke in either direction. It may be made to cut on either the up or down stroke by changing the crank pin to the opposite end of the crank arm. The amount of clearance is adjustable from 1/32-inch to 0 by means of a knurled-headed screw at the front of the frame.

There is a tilting table, and graduated readings are provided by which the machine can be set to file at any angle with mechanical exactness. It files a straight and true surface. A screw feed, operated by hand, is provided, by which the work can be fed to the file in any direction on the table. There is an adjustable strap to hold the work down to the table. This is especially useful in sawing and heavy filing.

An air pump is provided to blow away the chips and filings, by which the work and file are kept clean, thus insuring a smooth cut. Hardened dies, gauges, etc., can be lapped much faster and truer with the machine than is possible by hand. Four changes of speed are provided, from 60 to 450 revolutions per minute.

Many manufacturers are putting the machine into use in their manufacturing and finishing departments, and so performing filing or slotting operations at a great saving of expense. They use simple jigs or guides to hold and carry the parts to be filed or slotted, and employ boys where they have hitherto been obliged to have men of considerable skill.

When these machines are used for die-making, the desired sheer is obtained mechanically and is mechanically exact. Dies can be constructed with less sheer, and the less the sheer the less waste or impairment by sharpening. The die lasts longer.

With this machine, any ordinary handy man stands a better chance of avoiding rounded edges and of getting a true, flat surface and exact angles, than a skilled die-maker, working by hand and eye. But the same man, whether handy man or skilled die-maker, accomplishes so much more, after becoming familiar with the machine, that he effects a net saving of from 10 to 30 per cent.

Further details concerning this interesting machine will be gladly furnished by the manufacturers, the Cochrane-Bly Machine Works, of Rochester, New York.

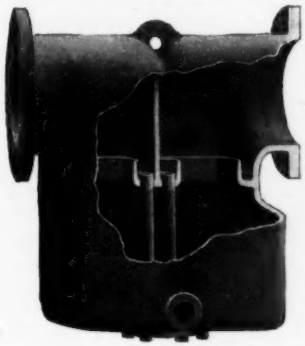
Oil Eliminator.

IN the accompanying illustration is shown an oil eliminator which was designed with especial reference to the easy flow of steam as well as the removal of oil or grease from it. The high velocity of the steam passing through the exhaust pipe makes it a question with many engineers whether or not it would be economical to use a separator and especially one which would in any way obstruct the flow of steam.

The machine illustrated has no working parts less than one and one-half times the area of the steam pipe, and there are no baffle plates or other serious obstructions to the flow of the steam.

The design of the machine is such that

the steam may flow in either direction, and the separation of the oil or grease is effected by means of troughs partially filled with water which entirely surround the inlet and outlet ports. These troughs entirely intercept the entrainment on the surface and the downward flow of steam on the inlet side, and throw any oil or water to the bottom of the reservoir. Pipes are provided for draining the excess of oil and water from the lower chamber, from which it is drawn off by means of a trap or receiver in the usual manner.



HOPPES OIL ELIMINATOR.

The machine is cast in one piece, which largely obviates the liability to leakage, a feature of great importance, especially in a vacuum line. The eliminators are made with pipe flanges, as shown in the figure, and also with companion flanges bolted directly to the body.

A new catalogue of this oil eliminator and also of the steam separators and exhaust heads made by the Hoppes Manufacturing Co. of Springfield, Ohio, are now ready for issue.

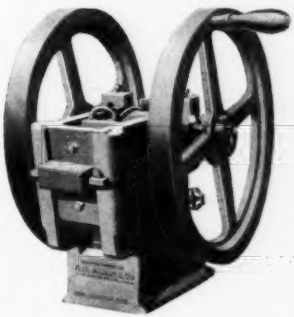
Simplex Ore Crusher.

A SHORT time ago a number of tests were made with a laboratory crusher manufactured by Messrs. F. W. Braun & Co., of Los Angeles, called the Simplex crusher, from the ease with which it may be cleaned and adjusted. The machine was operated by a ¼-H. P. motor, and speeded to 200 revolutions per minute. The average output with hard ore was 100 pounds per hour, crushed to a size such that all would pass a ¼-inch screen and half of it a 10-mesh screen. Soft ore could be crushed at the rate of 150 pounds per hour. Glass was pulverized from broken pieces about 2 inches in diameter to ¼ inch and smaller at the rate of 75 pounds per hour, and coal, in as large pieces as would drop between the jaws, was pulverized to a ¼ inch or smaller at the rate of 55 pounds per hour. Tests were also made with cement, granite, etc., with equally satisfactory results.

Owing to the peculiar crushing motion which is imparted to the jaw by the eccentric on the shaft, the material is crushed very rapidly, and as the lower portion of this jaw moves through an arc of a circle, it is forced to discharge. By removing the front jaw, which is easily accomplished by knocking out the wedge holding it in place, sufficient access can be had to the interior for ordinary cleaning, but if desired, the spring attachment which holds the vibratory jaw in place may be loosened, and the jaw swung completely out of its chamber. To do this requires no tools, and it may be entirely opened and closed for cleaning in less than a minute.

An especially good feature of the machine is that all portions which bear any strain are very heavy, thus reducing the danger of breakage to a minimum; the jaw and cheek plates are of steel and the jaw plates are reversible.

It has been aptly named the "ideal laboratory crusher," and is in use in many of the largest assaying offices throughout the country.



SIMPLEX ORE CRUSHER.

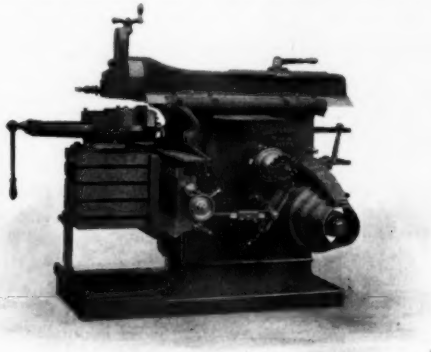
A larger size is also manufactured with a capacity of about one half greater, arranged to be used with either hand or power.

The manufacturers, Messrs. F. W.

Braun & Co., Los Angeles, California, would be pleased to send illustrated circulars on request.

Eberhardt's Patent Shaper With Sleeve Cone Support.

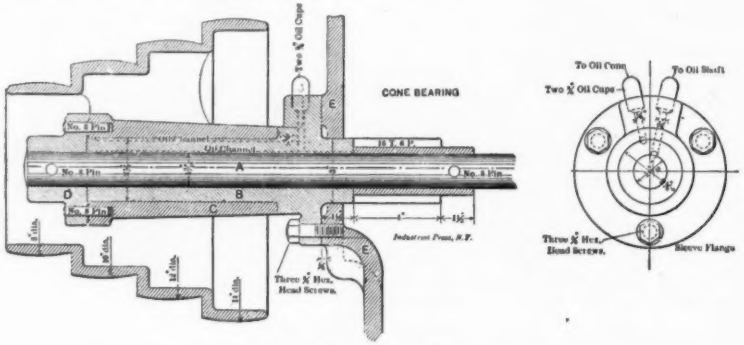
IN machine tools, many inconveniences arise from having overhanging cones and pulleys without an outer bearing support. In order to remedy these evils,



GOULD & EBERHARDT SHAPER.

Messrs. Gould & Eberhardt, the well-known manufacturers, are applying an improved sleeve cone support, which they have had patented, to their shapers and other machine tools.

As shown in the accompanying figure,



SLEEVE CONE SUPPORT.

the cone, C, is supported on a sleeve bearing, B, and drives the shaft, A, through the clutch flange, D. Connection is made between the cone, C, and the flange by means of taper pins, the pins being a tight fit in the flange and an easy fit in the cone. By employing this method of construction, the stress of the driving belt is carried entirely by the rigid sleeve journal, which is bolted by means of a flange to the side wall, E, of the shaper or other machine to which it may be applied. The driving shaft having only to transmit the torsional stress incident to driving the machine, the wear on it is reduced to a minimum, which insures the proper meshing of the driving gears indefinitely. With ordinary attention in the matter of lubrication, this bearing, all parts of which are cast iron, should outlast the machine.

A shaper is illustrated to which the improved cone support has been applied. This machine also embodies a number of other interesting improvements. The connecting

rod to the cross feed has a friction slip joint by means of which it automatically adjusts itself to the correct length when the table is raised or lowered. The friction joint also prevents the feed gears from breaking should the feed become blocked by accident or by the carelessness of the operator.

An arm projects over the cone, which bears numbers cast on the top corresponding to the different steps. These indicate the proper speeds for different lengths of stroke. All oil holes are provided with filter covers, which prevent the ingress of dirt, chips, etc., and filter all lubricant fed to the bearings. All the bearings are bushed where the wear is likely to become appreciable, so that all shafts may be readily brought back to their original centers.

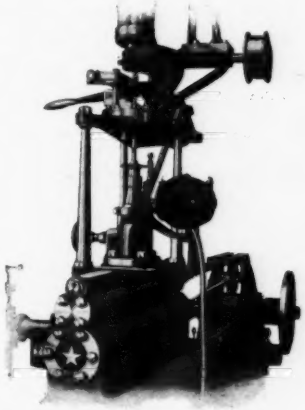
Further details concerning this machine tool or any of their other products will be gladly furnished by Gould & Eberhardt, of Newark, N. J.

Electric Speed Controller.

ON account of the increasing use of alternating current generators in large power plants, there has arisen a need for governing apparatus which shall be not only of the highest degree of perfection as regards speed regulation, but which shall also be adapted to meet all sorts of conditions. It is getting to be more and more the practice to control all parts of a plant from some central point corresponding to the conning tower of a ship, where are brought all the electric switches, indicators of every description and signal connections to and from all other points. The Lombard Governor Co., recognizing these facts, has recently made an improvement in its governors which adapts them perfectly to control from such a central situation, and, since the governors control the waterwheels and consequently the generators attached thereto, this improvement enables the officer in charge of the station to start up, stop, or alter the speed at will, of any or all of the machines under his supervision.

The apparatus for accomplishing this result is extremely simple, consisting merely of two small push buttons on each generator panel on the switchboard or pilot switchboard, which connect through three wires to a little electric motor, similar to those used for driving fans. This motor through suitable mechanism acts upon the valve stem of the governor in such a manner as to lengthen or shorten the connection between the centrifugal balls and the valve itself. The part of the device attached to the governor is shown very clearly in the illustration.

The method of operation is perfectly apparent, the small motor serving only in place of the attendant's fingers to shorten or lengthen the valve stem according to his will. Heretofore in bringing generators into synchronism it has usually been neces-

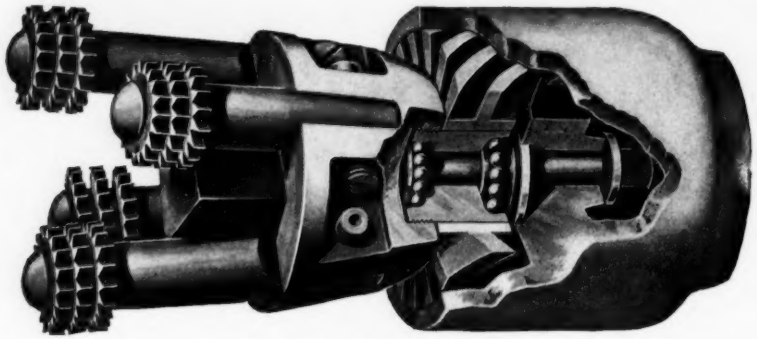


LOMBARD SPEED CONTROLLER.

sary for one man to watch the synchronizing lamps while an assistant stood by the side of the governor, gradually changing its speed according to signals received from the switchboard. Now the services of the man at the machine are not required, for the man at the switchboard with his fingers on the two push buttons can raise or lower the speed of the generator, which is to be thrown in multiple with others, without taking his eyes for an instant away from the synchronizing lamps or corresponding device. Thus there is not only a saving of time but also a more certain action. If it is desired, the man at the switchboard can without leaving his post shut down any generator, bringing it to a complete stop, and afterwards start it again. The gear connections from the motor are such that a delicacy of adjustment is possible, finer even than can be obtained by the fingers.

The motion is absolutely positive and there can be no change except by the will of the operator. Where alternating current generators are in use, current for the proper operation of the device is geneally obtained from an exciter circuit. Where it is desirable to use an independent source of energy, special motors are provided, to be run upon a primary or secondary battery circuit. There is no difficulty in operating the device with two cells of common dry batteries. There is no limit to the distance between the controlling push buttons and the governor. If the space is very great, e. g., several miles, telegraph relays are installed near the governor. Telephone or telegraph wires may thus be used, a suitable switch being arranged to throw them out of service for a few moments while synchronizing. Thus in electrical distribution systems, the speed at the generating stations may be controlled from the central distributing station.

Further information about this ingenious device will be cheerfully furnished by the Lombard Governor Co., of Boston.



WEINLAND BOILER-TUBE CLEANER.

Boiler-Tube Cleaner.

THE accompanying illustration shows the latest form of the turbine boiler-tube cleaner made by the Lagonda Manufacturing Company, of Springfield, Ohio, from the designs of Mr. Weinland. The motive power for driving the star-shaped cutters is the stream of water which flows through the turbine buckets shown, the rotary motion of which is transferred to a spider carrying the cutter arms. The water is brought to the cleaner under pressure through a hose attached to the back end by a patent coupling, which makes a perfectly smooth connection without any obstruction to the movement of the machine through the tubes or the water through the hose. The arms carrying the cutters are pivoted in the spider so as to move freely, the centrifugal force, when the cleaner is at work, forcing them against the tube. This spider is screwed fast to the turbine bucket wheel, which revolves on two sets of ball bearings. The head of the bolt holding the turbine in the shell and a steel cone set into the shell form the cones of the ball bearings, the cups being on either end of the turbine wheel. The guides for leading the water to the buckets are cut through the inner partition of the shell, as shown, and the water after leaving the cleaner serves to wash the refuse out of the tube and away from the cleaner. A considerable water pressure is desirable but not necessary in its operation.

The Lagonda Manufacturing Co. will cheerfully furnish any further information that may be desired.

Motor-Driven Engine Lathe.

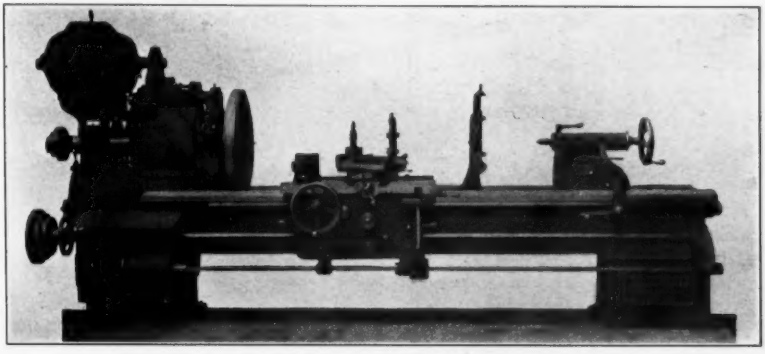
THE accompanying engraving shows a 24-inch engine lathe, with an improved method of electric drive, just brought out by The American Tool Works Company. The lathe itself is the regular standard machine, and embodies all the well known features of the "American" lathes. The drop V bed gives two inches additional swing without raising the head. The lead screw is on the inside of the bed, bringing

the pull directly under the cutting tool, thus centralizing the strain.

The 3-horse-power motor is of the double-commutator type and is mounted on a saddle on the head, with communication direct to the spindle by raw hide pinion and intermediate slip gear.

The controlling apparatus for starting, stopping and reversing, is simply and conveniently arranged at the right end of the carriage. There are four fundamental speeds obtainable from the motor itself, through the speed controller directly under the head. This, with the spindle gearing, gives a total of sixteen distinct and positive spindle speeds available. The efficiency of the motor is practically constant at all speeds, and it reverses at the same speed as when going forward.

Any further information regarding these machines will be gladly given by the American Tool Works Co., of Cincinnati, who are builders of lathes, planers, shapers, and upright and radial drills.



"AMERICAN" MOTOR-DRIVEN LATHE.

Star Steam-Engine Indicator.

UNDER the modern conditions of steam-engine practice, the equipment of an engine room is incomplete unless it is furnished with an indicator, or even a pair of indicators. In the instrument herewith described, there has been an endeavor to combine all the best features of the indicators which have preceded it, and at the same time to introduce some points of special design which none have heretofore possessed.

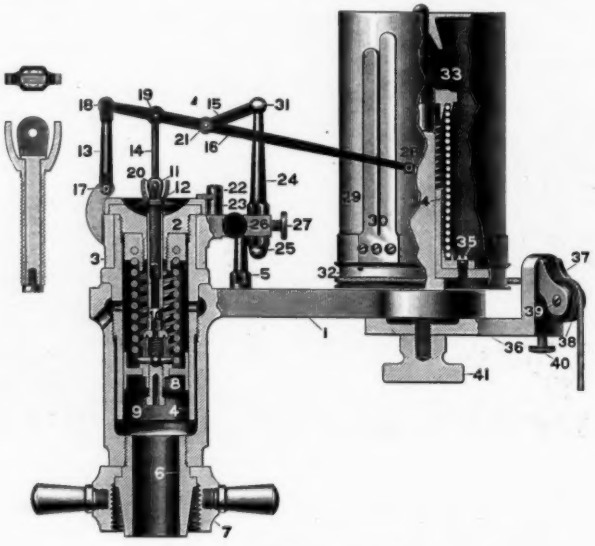
Viewed from the outside it will be found that the instrument is designed somewhat on the lines of the celebrated Thompson indicator, inasmuch as the pencil movement is of the Thompson pattern improved. This movement is chosen because it furnishes the most rigid arrangement of delicate levers that can be found for obtaining the rectilinear motion of the pencil desired. It is strong, durable, light in weight, and in all ways satisfactory. The interior design of the indicator is shown in the sectional cut. The lower end of the spring terminates in a simple ball or bead, which has met the test of a long and most successful period of service in other instruments.

Owing to the extreme lightness of this construction, and the fact that it is attained without sacrifice of strength, no arrangement could be more satisfactory. At the same time it furnishes a ball and socket connection between the spring and the piston, which is necessary in all indicators of the Richards type. The form of drum-spring adopted is the helical coil, which has been found by long experience and by accurate tests to furnish the most uniform tension on the driving cord.

One of the improvements introduced consists in the attachment of the cap at the top of the cylinder to the *interior* shell within which the piston moves, rather than to the outer shell, thus securing and maintaining the most correct alignment for the motion of the piston and its rod. At the same time the interior shell is movable, as in instruments which do not possess this feat-

ure. This arrangement also provides a jacket space filled with working steam completely surrounding the interior shell, and it secures a uniform temperature with absolute immunity from unequal expansion.

A noticeable feature to which attention is invited is the means for unscrewing and removing the cap from the cylinder with the parts attached to it. The cap has a milled edge of the usual construction, but, unlike instruments of previous makes, the edge is protected by a hard rubber non-conducting



STAR STEAM-ENGINE INDICATOR.

in the act of turning off the indicator cock. In previous designs the operator must often use considerable dexterity if he would avoid getting scalded with the escaping drops of hot water.

The piston rod of the Star improved indicator is provided with an adjustable swivelhead so planned that the position of the pencil arm can be varied and the atmospheric line drawn at any desired distance from the lower edge of the card, without going to the trouble of removing the piston

covering. This covering can be handled with absolute comfort to the one using it, whereas in the indicators heretofore made, as every one who has operated an indicator knows, it is impossible to unscrew the cap without risk of burning the thumb and finger with the hot metal. Another thing which will be appreciated by those having the active handling of the instrument, is the provision of a vent tube for carrying away the waste steam and hot water which blows by the piston. This tube is attached to the side of the cylinder and it extends a sufficient distance below the body of the instrument to fully clear it, and prevent the hot water which is mixed with the steam from dripping on the hand of the operator while and its mechanism from the cylinder. It is simply necessary to screw the swivelhead up or down the desired amount, using the thumb and finger.

A new form of detent motion is used in this instrument. The makers have discarded the ratchet and pawl which has become familiar by extended employment heretofore, and designed a form of friction clutch which is exceedingly simple and effective. It consists simply of a ball which is thrown into contact with a groove in the circumference of the drum-base.

Most of the details are clearly shown in the cut, but any further information will be gladly given by the manufacturers, the Star Brass Manufacturing Co., of Boston.